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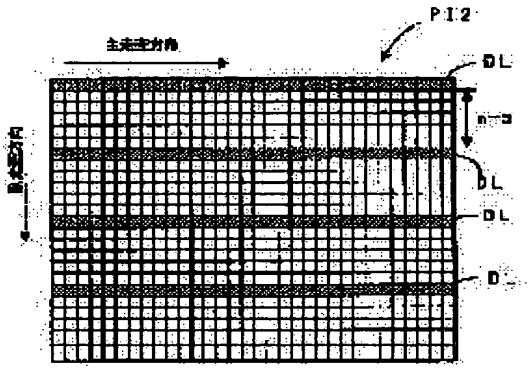
(54) IMAGE FORMING DEVICE AND IMAGE FORMING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain an image forming device and image forming method where the image density of a line image can be stabilized.
SOLUTION: In this device, a patch image PI2 is constituted from the multiple number of 1 dot lines DL that are installed separately from each other, the image density of this patch image PI2 is detected and the image density of a toner image is adjusted to a target density based on the detected result. Therefore, the image density of the line image consisting of 1 dot lines DL can be stabilized and even a precise image can be stably formed at an appropriate image density.



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CLAIMS

[Claim(s)]
[Claim 1] It is image formation equipment which is equipped with the following and characterized by said patch image consisting of two or more 1-dot lines by which isolation arrangement was carried out mutually. An electrification means to electrify a front face of a photo conductor An exposure means to form an electrostatic latent image in a front face of said photo conductor A development means to actualize said electrostatic latent image with a toner, and to form a toner image A concentration detection means by which said development means detects the image concentration by using as a patch image a toner image formed on said photo conductor, or a toner image with which a transfer medium comes to imprint the toner image concerned, and a control means which adjusts image concentration of a toner image to aim concentration based on a detection result of said concentration detection means
[Claim 2] Said control means is image formation equipment according to claim 1 which determines the optimal electrification bias required [changing electrification bias gradually,] in order to obtain aim concentration based on concentration of each patch image which carried out sequential formation of said two or more patch images, and was detected by said concentration detection means.
[Claim 3] Said control means is image formation equipment according to claim 2 which forms said two or more batch images while increasing electrification bias gradually.
[Claim 4] Said electrification means is image formation equipment according to claim 1 to 3 which contacts a conductor which was able to give electrification bias on a front face of said photo conductor, and carries out contact electrification of the front face concerned.
[Claim 5] Said 1-dot lines which are almost parallel to mutual as for a 1-dot line of a book, and moreover adjoin are image formation equipment according to claim 1 to 4 which only a n line gap (integer of n>=2) is isolating.
[Claim 6] A line gap n of the 1-dot lines which adjoin when said concentration detection means has a detection field of magnitude phi and said image formation equipment has resolution R is image formation equipment according to claim 5 which is the integer with which are further satisfied of n<= (phi-R -10) / 10.
[Claim 7] A line gap n of the 1-dot lines which adjoin when said concentration detection means has a detection field of magnitude phi and said image formation equipment has resolution R is image formation equipment according to claim 5 which is the integer with which are further satisfied of n<= (phi-R -20) / 20.
[Claim 8] Said patch image is image formation equipment according to claim 1 to 4 which is said grid image which comes to arrange two or more 1-dot lines of a book in the shape of a grid.
[Claim 9] Said patch image is image formation equipment according to claim 8 which is said rectangular grid image which comes to carry out rectangular arrangement of two or more 1-dot lines of a book mutually.
[Claim 10] In an image formation method which forms an electrostatic latent image in a front face of this photo conductor, actualizes said electrostatic latent image with a toner, and forms a toner image with a development means further after electrifying a front face of a photo conductor with an electrification means Changing a concentration controlling factor which affects image concentration of a toner image An image formation method characterized by determining optimal concentration controlling factor required [after carrying out sequential formation of the toner image which consists of two or more 1 dot lines by which isolation arrangement was carried out mutually as a patch image] in order to detect concentration of each patch image and to obtain aim concentration based on those image concentration.
[Claim 11] An image formation method according to claim 10 of determining the optimal electrification bias required [after carrying out sequential formation of two or more toner images as a patch image, changing electrification bias given to said electrification means as said concentration controlling factor] in order to detect concentration of each patch image and to obtain aim concentration based on those image concentration.
[Claim 12] An image formation method according to claim 11 which forms said two or more batch images while increasing electrification bias gradually.
[Claim 13] Said 1-dot lines which are almost parallel to mutual as for a 1-dot line of a book, and moreover adjoin are the image formation methods according to claim 10 to 12 which only a n line gap (integer of n>=2) is isolating.
[Claim 14] An image formation method according to claim 13 which forms said patch image so that a line gap n of adjoining 1-dot lines may serve as an integer with which are further satisfied of n<= (phi-R -10) / 10, when detection area size of a patch image is set to phi and resolution is set to R.
[Claim 15] An image formation method according to claim 13 which forms said patch image so that a line gap n of adjoining 1-dot lines may serve as an integer with which are further satisfied of n<= (phi-R -20) / 20, when

detection area size of a patch image is set to phi and resolution is set to R.
[Claim 16] An image formation method according to claim 10 to 12 which is using said patch image as said grid image which comes to arrange two or more 1-dot lines of a book in the shape of a grid.
[Claim 17] An image formation method according to claim 16 which is using said patch image as said rectangular grid image which comes to carry out rectangular arrangement of two or more 1-dot lines of a book mutually.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the image formation equipment and the image formation method of forming an electrostatic latent image in the front face of this photo conductor, and actualizing said electrostatic latent image with a toner, and forming a toner image with a development means, further, after electrifying the front face of a photo conductor with an electrification means.
[0002]
[Description of the Prior Art] With this kind of image formation equipment, it may originate in fatigue and aging of a photo conductor and a toner, change of the temperature and humidity in the equipment circumference, etc., and. image concentration may change. Then, many technology of adjusting suitably the concentration controlling factor which affects the image concentration of a toner image conventionally, for example, electrification bias, development bias, light exposure, etc., and stabilizing image concentration is proposed. For example, the patch image which comes to output the pair group of a 3-dot line to JP,9-50155,A by invention of a publication every 3 dots was formed in photo conductor drum lifting, and line width of face is detected by reading this patch image by the sensor. And light exposure was adjusted so that desired line width of face might be obtained by controlling laser power based on the line width of face detected in this way, and the line line drawing image of an ideal has been obtained.
[0003]
[Problem(s) to be Solved by the Invention] However, the bases of a line drawing image are 1-dot lines drawn by one laser beam, and cannot say that the line drawing image was fully adjusted like the conventional example only by controlling the line width of face of two or more dot line.
[0004] This invention is made in view of the above-mentioned technical problem, and it aims at offering the image formation equipment and the image formation method of stabilizing the image concentration of a line drawing image.
[0005]
[Means for Solving the Problem] An electrification means by which image formation equipment concerning this invention electrifies a front face of a photo conductor, An exposure means to form an electrostatic latent image in a front face of said photo conductor, and a development means to actualize said electrostatic latent image with a toner, and to form a toner image, A toner image formed on said photo conductor by said development means or a toner image with which a transfer medium comes to imprint the toner image concerned is used as a patch image. In order to have a concentration detection means to detect the image concentration, and a control means which adjusts image concentration of a toner image to aim concentration based on a detection result of said concentration detection means and to attain the above-mentioned object, said patch image consists of two or more 1-dot lines by which isolation arrangement was carried out mutually.
[0006] Moreover, after an image formation method concerning this invention electrified a front face of a photo conductor with an electrification means, In order to form an electrostatic latent image in a front face of this photo conductor, to be the image formation method which actualizes said electrostatic latent image with a toner by development means, and forms a toner image further and to attain the above-mentioned object, Changing a concentration controlling factor which affects image concentration of a toner image After carrying out sequential formation of the toner image which consists of two or more 1-dot lines by which isolation arrangement was carried out mutually as a patch image, concentration of each patch image was detected and optimal concentration controlling factor required in order to obtain aim concentration based on those image concentration is determined.
[0007] A toner image which consists of these invention with two or more 1-dot lines by which isolation arrangement was carried out mutually is formed as a patch image. And while image concentration of this patch image is detected, based on that detection result, stabilization of image concentration of a line drawing image with which image concentration of a toner image is adjusted to aim concentration, and consists of a 1-dot line is attained.
[0008] In addition, about adjustment of image concentration, it is good in a line as follows, for example. That is, after carrying out sequential formation of two or more toner images as a patch image, changing electrification bias given to an electrification means as a concentration controlling factor which affects image concentration of a toner image, decision **** is good in the optimal electrification bias required in order to detect concentration of each patch image and to obtain aim concentration based on those image concentration.
[0009] Moreover, in case electrification bias is changed, it is desirable to make it increase gradually. It is because a direction changed in the buildup direction rather than the reduction direction is excellent in respect of the responsibility of a power supply when changing electrification bias in step. Thus, contact electrification can be used

as a concrete means to change electrification bias gradually.
[0010] Moreover, about two or more 1-dot lines which constitute a patch image, it is almost parallel to mutual and it is desirable for adjoining 1-dot lines to isolate only a n line gap (integer of n>=2) moreover. Moreover, detection area size of a concentration detection means is set to phi, it is desirable to set R, then the adjoining line gap n of 1-dot lines as n<= (phi-R -10) / 10 for resolution of image formation equipment, and it is more more suitable still to set it as n<= (phi-R -20) / 20. Thus, a reason with desirable setting up a upper limit and a lower limit of the line gap n is explained in full detail by next "gestalt of implementation of invention", and term of an "example."
[0011] Furthermore, a patch image may be constituted from a grid image which comes to arrange two or more 1-dot lines in the shape of a grid, the number of lines which goes into a detection field of a concentration detection means compared with a patch image which carried out parallel arrangement of two or more 1-dot lines in this case increases, and detection sensitivity increases more.
[0012]
[Embodiment of the Invention] A. The whole image formation equipment block diagram 1 is drawing showing the operation gestalt of 1 of the image formation equipment concerning this invention. Moreover, drawing 2 is the block diagram showing the electric configuration of the image formation equipment of drawing 1 . This image formation equipment is yellow (Y), cyanogen (C), a Magenta (M), and equipment that piles up the toner of four colors of black (K) and forms a monochrome image, using only the toner of black (K) in forming a full color image ****. With this image formation equipment, if a picture signal is given to the Maine controller 11 of a control unit 1 from external devices, such as a host computer, according to the command from this Maine controller 11, the engine controller 12 will control each part of the engine section E, and the image corresponding to a picture signal will be formed in Sheet S.
[0013] A toner image can be formed in the photo conductor 21 of the image support unit 2 in this engine section E. That is, the image support unit 2 is equipped with the pivotable photo conductor 21 in the direction of an arrow head of drawing 1 , and the electrification roller 22 as an electrification means, the development counters 23Y, 23C, 23M, and 23K as a development means, and the cleaning section 24 are further arranged along the hand of cut, respectively around the photo conductor 21. High tension is impressed from the electrification bias generating section 121, and the electrification roller 22 electrifies a peripheral face in homogeneity in contact with the peripheral face of a photo conductor 21.
[0014] And laser beam L is irradiated from the exposure unit 3 towards the peripheral face of the photo conductor 21 charged with this electrification roller 22. As shown in drawing 2 , it connects with the picture signal change over section 122 electrically, and this exposure unit 3 carries out scan exposure of the laser beam L on a photo conductor 21 according to the picture signal given through this picture signal change over section 122, and forms the electrostatic latent image corresponding to a picture signal on a photo conductor 21. For example, when the picture signal change over section 122 has flowed with the patch creation module 124 based on the command from CPU123 of the engine controller 12, the patch picture signal outputted from the patch creation module 124 is given to the exposure unit 3, and a patch latent image is formed. On the other hand, when the picture signal change over section 122 has flowed with CPU111 of the Maine controller 11, according to the picture signal given through the interface 112 from external devices, such as a host computer, scan exposure of the laser beam L is carried out on a photo conductor 21, and the electrostatic latent image corresponding to a picture signal is formed on a photo conductor 21.
[0015] In this way, toner development of the formed electrostatic latent image is carried out by the development section 23. That is, in this operation gestalt, development counter 23K for development counter 23M and blacks development counter 23Y for yellow, development counter 23C for cyanogen, and for Magentas are arranged along with the photo conductor 21 as the development section 23 in this sequence. These development counters 23Y, 23C, 23M, and 23K While it is constituted free [attachment and detachment] to the photo conductor 21, respectively and the development counter of one of the four above-mentioned development counters 23Y, 23M, 23C, and 23B contacts a photo conductor 21 selectively according to the command from the engine controller 12 By the development bias generating section 125, high tension gives the toner of the color impressed and chosen to the front face of a photo conductor 21, and actualizes the electrostatic latent image on a photo conductor 21.
[0016] the toner image developed in the development section 23 — the object for blacks — it imprints primarily on the medium imprint belt 41 of the imprint unit 4 in the primary imprint field R1 located between development counter 23K and the cleaning section 24. In addition, the structure of this imprint unit 4 is explained in full detail later.
[0017] Moreover, it is failed after a primary imprint for the cleaning section 24 to be arranged from the primary imprint field R1 in the location which went to the hoop direction (the direction of an arrow head of drawing 1), and to scratch the toner which is carrying out residual adhesion to the peripheral face of a photo conductor 21.
[0018] Next, the configuration of the imprint unit 4 is explained. The imprint unit 4 is equipped with rollers 42-47, the medium imprint belt 41 over which each [these] rollers 42-47 were built, and the secondary imprint roller 48 which imprints secondarily the medium toner image imprinted by this medium imprint belt 41 on Sheet S with this operation gestalt. Primary imprint voltage is impressed to this medium imprint belt 41 from the imprint bias generating section 126. And in imprinting a color picture on Sheet S, while piling up the toner image of each color formed on a photo conductor 21 on the medium imprint belt 41 and forming a color image, by the feed section 63 of the feeding-and-discarding paper unit 6, Sheet S is picked out from a cassette 61, a detachable tray 62, or a duplication cassette (graphic display abbreviation), and it conveys to the secondary imprint field R2. And a color image is secondarily imprinted on this sheet S, and a FURU color picture is obtained. Moreover, in imprinting a

monochrome image on Sheet S, only a black toner image is formed on the medium imprint belt 41 on a photo conductor 21, and it imprints on the sheet S conveyed to the secondary imprint field R2 like the case of a color picture, and obtains a monochrome image.
[0019] In addition, about the toner which is carrying out residual adhesion, it is removed by the peripheral face of the medium imprint belt 41 with a belt cleaner 49 after a secondary imprint. On both sides of the medium imprint belt 41, this belt cleaner 49 counters with a roller 46, is arranged, and a cleaner blade contacts to the medium imprint belt 41 to suitable timing, and it fails to scratch the toner which is carrying out residual adhesion to that peripheral face.
[0020] Moreover, while the patch sensor PS for detecting the concentration of the patch image formed in the peripheral face of the medium imprint belt 41 as mentions later near the roller 43 is arranged, the reading sensor RS for a synchronization for detecting the criteria location of the medium imprint belt 41 is arranged.
[0021] It returns to drawing 1 and configuration explanation of the engine section E is continued. The sheet S by which the toner image was imprinted with the imprint unit 4 is conveyed by the fixation unit 5 arranged in the downstream of the secondary imprint field R2 by the feed section 63 of the feeding-and-discarding paper unit 6 in accordance with the predetermined feed path (two-dot chain line), and is fixed to Sheet S in the toner image on the sheet S conveyed. And the sheet S concerned is further conveyed by the delivery unit 64 in accordance with the feed path 630.
[0022] While this delivery unit 64 has two delivery paths 641a and 641b and one delivery path 641a is prolonged in a standard paper output tray from the fixation unit 5, delivery path 641b of another side is mostly prolonged between the re-feeding section 66 and a multi-bottle unit in parallel with delivery path 641a. In accordance with these delivery paths 641a and 641b, 3 sets of roller pair 642-644 are prepared, turn the sheet [finishing / fixation] S to a standard paper output tray and multi-bottle unit side, and it discharges, or in order to form an image also in the another side side side, it conveys to the re-feeding section 66 side.
[0023] the sheet S by which reversal conveyance has been carried out as mentioned above from the delivery unit 64 as this re-feeding section 66 is shown in drawing 1 — the re-feeding path 664 (two-dot chain line) — meeting — the gate roller pair of the feed section 63 — three which conveys to 637 and were arranged in accordance with the re-feeding path 664 — re--- it consists of feed roller pair 661-663. thus, the sheet S conveyed from the delivery unit 64 — the re-feeding path 664 — meeting — a gate roller pair — by returning to 637, in the feed section 63, the non-image formation side of Sheet S turns to the medium imprint belt 41, and the secondary imprint of an image of it is attained in the field concerned.
[0024] In addition, in order to memorize the image with which the sign 113 was given through the interface 112 in drawing 2 from external devices, such as a host computer, it is the image memory established in the Maine controller 11, and a sign 127 is RAM for memorizing temporarily the result of an operation in control data and CPU123 for controlling the engine section E etc., and a sign 128 is ROM which memorizes the operation program performed by CPU123 further.
[0025] B. Explain concentration adjustment actuation of the concentration adjustment actuation in image formation equipment, next an image [in / it is constituted as mentioned above and / image formation equipment].
[0026] Drawing 3 is a flow chart which shows the concentration adjustment actuation in the image formation equipment of drawing 1 . With this image formation equipment, as shown in this drawing, it is judged whether it is necessary to perform concentration adjustment actuation at step S1, and to carry out updating setting out of development bias and the electrification bias. For example, if it will be in the condition that an image can be formed after switching on the Maine power supply of the main part of image formation equipment, you may constitute so that bias setting out may be started. Moreover, continuous duty time amount is measured and you may make it start bias setting out every several hours by the timer (graphic display abbreviation) formed in the main part of equipment.
[0027] If it is judged as "YES" at this step S1 and bias setting out is started, the optimal development bias will be computed by performing steps S2 and S3, and it will be set up as development bias (step S4). Moreover, the optimal electrification bias is computed by performing step S5 following it, and it is set up as electrification bias (step S6). In this way, optimization of development bias and electrification bias is performed. Hereafter, the content of development bias calculation processing (step S3) and electrification bias calculation processing (step S5) is explained to details, respectively.
[0028] B-1. Development bias calculation processing drawing 4 is a flow chart which shows the content of development bias calculation processing of drawing 3 . In this development bias calculation processing (step S3), after the Maine power supply of the main part of image formation equipment is switched on first, it judges whether it is being carried out to the beginning, or 2nd henceforth (step S301). And when it is judged as the first time, they are all colors (with this operation gestalt). It progresses to step S312, after setting up yellow (Y), cyanogen (C), a Magenta (M), and the purport that forms a patch image about four colors of black (K) (step S311). In a comparatively large range And changing development bias gradually at a comparatively large gap, two or more patch images are formed and it asks for development bias required in order to obtain the optimal image concentration based on the concentration of each patch image provisionally. It explains in full detail, reaching and carrying out drawing 6 reference of drawing 5 about the content of processing.
[0029] Drawing 5 is a flow chart which shows the content of bias calculation processing in the extensive range of drawing 4 . Moreover, drawing 6 is the mimetic diagram showing the content of processing of drawing 5 , and the content of bias calculation processing in the ** range explained later. In this calculation processing, the color which

creates a patch image is set to the first color, for example, yellow, (step S312a). And it is the default which set up electrification bias at step S2 beforehand, and development bias is set as four steps at a comparatively large gap (the 1st gap) within the limits of an extensive range (step S312b). For example, with this operation gestalt, by the development bias generating section 125, the whole adjustable band (Vb01-Vb10) of the development bias which can be supplied to the development section 23 was set up as an extensive range, and Vb01, Vb04, Vb07, and Vb10 are set up as development bias. [four / of the points in this extensive range (Vb01-Vb10)] Thus, the 1st gap W1 is set to W1=Vb10-Vb07=Vb07-Vb04=Vb04-Vb01 with this operation gestalt.

[0030] As sequential formation of the four yellow solid images (drawing 7) is carried out on a photo conductor by such bias setting out and it is further shown in drawing 8 (a), these are imprinted to the peripheral face of the medium imprint belt 41, and the 1st patch image PI 1 is formed (step S312c). In addition, with this operation gestalt, although the 1st patch image PI 1 is used as the solid image, that reason is explained in full detail later.

[0031] While judging whether the following step S312d created the patch image about all patch creation colors and being judged as "NO" As a patch creation color is set as the following color (step S312e), step S312b and S312c are repeated and it is shown in drawing 8 (b) - (d), cyanogen (C), The 1st patch image PI 1 is further formed on the peripheral face of the medium imprint belt 41 in order of a Magenta (M) and black (K).

[0032] On the other hand, if it is judged as "YES" by step S312d, the image concentration of the patch image PI 1 of 16 (= four-kind x4 color) individuals will be measured by the patch sensor PS (step S 312f). With this operation gestalt, after forming the patch image PI 1 about all patch creation colors, the image concentration of the patch image PI 1 is measured collectively, but whenever it forms the patch image PI 1 of each patch creation color, it may be made to carry out sequential measurement of the image concentration of the patch image PI 1. It is [in / about this point / next bias calculation processing (drawing 9 , drawing 10 , and drawing 12)] the same.

[0033] It can come, and is alike, then asks for the development bias corresponding to aim concentration by step S312g, and it is temporarily memorized to RAM127, using this as provisional bias. Here, when the measurement result (image concentration) is in agreement with aim concentration, it can ask for provisional bias by linear interpolation, equalization processing, etc. based on the data D (Vb04) and D (Vb07) which sandwiches aim concentration for the development bias corresponding to the image concentration as it shows in drawing 6 (b), provisional bias then in are good and not being in agreement.

[0034] In this way, if provisional bias can be found, bias calculation processing (1) in the ** range of drawing 4 will be performed. Drawing 9 is a flow chart which shows the content of bias calculation processing (1) in the ** range of drawing 4 . In this calculation processing, the color which creates a patch image is set to the first color, for example, yellow, like previous calculation processing (step S312) (step S313a). And development bias is set as four steps at a gap (the 2nd gap) narrower than the 1st gap W1 within the limits of a ** range containing the provisional bias for which is the default which set up electrification bias at step S2 beforehand, and it asked at step S312 (step S313b). for example, — this operation gestalt — about [of the adjustable band (Vb01-Vb10) of development bias] — one third is set up as a ** range, and as provisional bias shows drawing 6 (b), in being between the development bias Vb05 and Vb06, it has set up four Vb04, Vb05, Vb06, and Vb07 as development bias (this drawing (c)). Thus, the 2nd gap W2 is set to W2=Vb07-Vb06=Vb06-Vb05=Vb05-Vb04 with this operation gestalt.

[0035] As sequential formation of the four yellow solid images (drawing 7) is carried out on a photo conductor by such bias setting out and it is further shown in drawing 8 (a), these are imprinted to the peripheral face of the medium imprint belt 41, and the 1st patch image PI 1 is formed (step S313c). And until it judges that the patch image was created about all patch creation colors by step S313d as well as previous calculation processing (step S312) A patch creation color is set as the following color (step S313e), step S313b and S313c are repeated, and the 1st patch image PI 1 is further formed on the peripheral face of the medium imprint belt 41 in order of cyanogen (C), a Magenta (M), and black (K).

[0036] In this way, if the patch image PI 1 of 16 (= four-kind x4 color) individual is formed in the medium imprint belt 41, the image concentration of each patch image will be measured by the patch sensor PS (step S 313f). It can come, and is alike, then asks for the development bias corresponding to aim concentration by step S313g. Here, when the measurement result (image concentration) is in agreement with aim concentration, it can ask for the optimal development bias by the linear interpolation based on the data D (Vb05) and D (Vb06) which sandwiches aim concentration for the development bias corresponding to the image concentration as it shows in drawing 6 (d), provisional bias then in are good and not being in agreement, etc.

[0037] In this way, about the called-for optimal development bias, it memorizes to RAM127 (step S302 of drawing 4), and in the time of calculation of the electrification bias mentioned later, or the usual image formation processing, it reads from RAM127 and sets up as development bias.

[0038] As mentioned above, with this operation gestalt, it is an extensive range, and asks for development bias required in order to obtain the image of aim concentration at the 1st gap W1 provisionally, and it is the ** range which contains provisional bias further, and asks for development bias required in order to set up development bias at the moreover more fine gap (the 2nd gap) W2 and to obtain aim concentration, and this is eventually made into the optimal development bias. Therefore, the following effects are acquired.

[0039] For example, when the Maine power supply of the main part of image formation equipment is switched on, the property of a photo conductor or a toner, the temperature and humidity of the equipment circumference, etc. cannot expect at all how it is changing, but after setting up development bias so that the whole development bias adjustable band (Vb01-Vb10) may be covered, they need to form a patch image, and need to determine the optimal development bias. Then, it is also possible to divide a development bias adjustable band (Vb01-Vb10) into two or

more ** range, to perform the above-mentioned bias calculation processing (1) and same processing in each ** range, and to ask for the optimal development bias. However, in this example of a comparison, the number of steps increases in proportion to the number of partitions, and there is a problem that calculation of the optimal development bias will take time amount. On the contrary, if the number of partitions is lessened, another problem that breadth, consequently calculation precision of the optimal development bias cannot fall, and the bias gap within one division range of what can solve the above-mentioned problem cannot adjust image concentration to aim concentration rather than the 2nd bias gap W2 at accuracy will arise.

[0040] On the other hand, with this operation gestalt, after asking for near development bias provisionally by bias calculation processing (step S312) in an extensive range as mentioned above, it is a ** range near the provisional bias further, and since the optimal development bias is computed by moreover changing development bias at the fine gap (the 2nd gap) W2, compared with the above-mentioned example of a comparison, it is a short time and, moreover, high degree of accuracy can be asked for the optimal development bias.

[0041] By the way, although the optimal electrification bias and the optimal development bias change according to fatigue, aging, etc. of a photo conductor and a toner, the change has a certain amount of continuity. Therefore, when repeating and performing adjustment processing of image concentration, the optimal development bias can be expected based on the last image density measurement result (step S 313f, step S322f, S510 which are mentioned later, etc.). so, in the development bias calculation processing (step S3) concerning this operation gestalt When it judges that it is 2nd henceforth, that is, is judged as "2nd henceforth" at step S301 of drawing 4 after the Maine power supply of the main part of image formation equipment was switched on all colors (this operation gestalt — yellow (Y), cyanogen (C), and a Magenta (M) —) After setting up the purport which forms a patch image about four colors of black (K) (step S321), it is asking for the optimal development bias, without progressing to step S322, performing bias calculation processing (2) in a ** range, and asking for provisional bias. Hereafter, it explains, referring to drawing 10 about the content of processing.

[0042] Drawing 10 is a flow chart which shows the content of bias calculation processing (2) in the ** range of drawing 4 . Moreover, drawing 11 is the mimetic diagram showing the content of processing of drawing 10 . The point that this calculation processing is greatly different from bias calculation processing (1) in the ** range explained previously While setting electrification bias as a default in calculation processing (1) of drawing 9 As opposed to that which has set up four kinds of development bias in a ** range based on provisional bias (step S313b) While setting up the optimal electrification bias which is called for by the last image density measurement in this bias calculation processing (2), and is memorized by RAM127 as electrification bias It is the point of having set up four kinds of development bias in a ** range based on the optimal development bias memorized by this RAM127 (step S322b), and other configurations are the same. Therefore, it omits about explanation of the same configuration here.

[0043] Thus, since are a ** range, four kinds of development bias is moreover set up at the 2nd gap using the last image density measurement result (the last optimal development bias), the patch image of each color is formed, without asking for provisional bias and he is trying to ask for the optimal development bias about concentration adjustment actuation of the 2nd henceforth, it can ask for the optimal development bias further further in a short time. In addition, about the optimal development bias called for in this way, it rewrites with the optimal development bias already memorized by RAM127, and updates to the newest thing (step S302 of drawing 4).

[0044] In this way, if the optimal development bias can be found, return and the optimal development bias computed as mentioned above will be read from RAM127 to drawing 3 , and this will be set up as development bias. And the optimal electrification bias is computed (step S5), and it is set up as electrification bias (step S6).

[0045] B-2. Optimal electrification bias calculation processing drawing 12 is a flow chart which shows the content of electrification bias calculation processing of drawing 3 . Moreover, drawing 13 is the mimetic diagram showing the content of processing of drawing 10 . in this electrification bias calculation processing (step S5), after setting up the purport which forms a patch image about all colors (this operation gestalt — four colors of yellow (Y), cyanogen (C), a Magenta (M), and black (K)) (step S501), the color which progresses to step S502 and creates the 2nd patch image is set to the first color, for example, yellow, (step S501).

[0046] And after the Maine power supply of the main part of image formation equipment is switched on like the case of development bias calculation processing, when it judges whether it is that electrification bias calculation processing is performed first or 2nd henceforth (step S503) and is judged as the first time, step S504 is performed, and when it is judged that it is 2nd henceforth, step S505 is performed.

[0047] In this step S504, electrification bias is set as four steps at a comparatively narrow gap (the 3rd gap) within the limits of a ** range, including the default beforehand set up at step S2. On the other hand, in step S505, electrification bias is set as four steps at a comparatively narrow gap (the 3rd gap) within the limits of a ** range based on the last image density measurement result (the optimal electrification bias). Thus, only calculation processing in a ** range is performed, without electrification bias calculation processing performing calculation processing in an extensive range unlike development bias calculation processing. in addition — this operation gestalt — about [of the adjustable band (Va01-Va10) of electrification bias] — as one third is set up as a ** range, for example, a default or the last optimal electrification bias shows drawing 13 (a), in being between the electrification bias Va05 and Vb06, it has set up four Va04, Va05, Va06, and Va07 as electrification bias. Thus, 3rd gap W3 is set to W3=Va07-Va06=Va06-Va05=Va05-Va04 with this operation gestalt.

[0048] If four kinds of electrification bias is set up about a yellow color as mentioned above, increasing electrification bias gradually from the lowest value Va04, sequential formation of the halftone image (drawing 14) of each yellow will be carried out on a photo conductor, these will be imprinted to the peripheral face of the medium

imprint belt 41, and the 2nd patch image PI 2 will be formed (drawing 8 (a): step S506). Thus, it is because the direction changed in the buildup direction rather than the reduction direction is excellent in respect of the responsibility of a power supply when changing electrification bias in step to increase electrification bias gradually. In addition, although the 2nd patch image PI 2 is used as the halftone image which comes to carry out parallel arrangement with this operation gestalt while only a five-line gap (n= 5) isolates two or more 1-dot lines mutually, the 1st patch image is combined with the reason used as the solid image about that reason, and it explains in full detail later.

[0049] While judging whether the following step S507 created the 2nd patch image about all patch creation colors and being judged as "NO" As a patch creation color is set as the following color (step S508), steps S503-S507 are repeated and it is shown in drawing 8 (b) - (d), cyanogen (C), The 2nd patch image PI 2 is further formed on the peripheral face of the medium imprint belt 41 in order of a Magenta (M) and black (K).

[0050] On the other hand, if it is judged as "YES" at step S507, the image concentration of the patch image PI 2 of 16 (= four-kind x4 color) individuals will be measured by the patch sensor PS (step S509). Moreover, it can come, and is alike, then asks for the electrification bias corresponding to aim concentration at step S550 (step S510), and memorizes to RAM127 by making this into the optimal electrification bias (step S511). Here, when the measurement result (image concentration) is in agreement with aim concentration, it can ask for the optimal electrification bias by the linear interpolation based on the data D (Va05) and D (Va06) which sandwiches aim concentration for the electrification bias corresponding to the image concentration as it shows in drawing 13 (b), the optimal electrification bias then in are good and not being in agreement, etc.

[0051] In this way, if the optimal electrification bias can be found, in addition to having already set up the optimal development bias as development bias, the optimal electrification bias computed as mentioned above will be read from RAM127, and this will be set up as electrification bias. And if image formation is performed under these setting out, an image can be formed by aim concentration and stabilization of image concentration can be attained.

[0052] As mentioned above, according to this operation gestalt, in quest of the optimal electrification bias and the optimal development bias, image concentration can be adjusted to aim concentration, and image concentration can be stabilized. Each patch image PI 2 is especially constituted from this operation gestalt with two or more 1-dot lines by which isolation arrangement was carried out mutually. Since the image concentration of each patch image PI 2 is detected and the image concentration of a toner image is adjusted to aim concentration based on the detection result, From the first, also about the line drawing image which consists of a 1-dot line, stabilization of image concentration can be attained, by suitable image concentration, a precise image is also stabilized and the line drawing image which consists of a P (P>=2) dot line can form it.

[0053] Moreover, about the optimal electrification bias, since it performs after setting up the optimal development bias called for by processing just before the calculation processing as development bias, high degree of accuracy can be asked for the optimal electrification bias.

[0054] Moreover, in development bias calculation processing of the 2nd henceforth, and electrification bias calculation processing, since bias calculation is performed based on the last image density measurement result (the optimal electrification bias and the optimal development bias), it is a short time and can ask for the newest optimal electrification bias and the newest optimal development bias with a sufficient precision.

[0055] C. The reason is as follows, although the halftone image which comes to carry out parallel arrangement is used as the 2nd patch image by electrification bias calculation processing while only a n line gap isolates two or more 1-dot lines mutually while using a solid image as the 1st patch image by development bias calculation processing with the above-mentioned operation gestalt by the way about a patch image.

[0056] If the electrostatic latent image LI1 equivalent to the solid image (the 1st patch image) PI 1 (drawing 7) is formed in the front face of the photo conductor 21 charged in homogeneity in surface potential V0, as shown in drawing 15 , the surface potential equivalent to the electrostatic latent image LI1 will be greatly lowered to it to potential (latent-image low section potential) VON, and square well potential will be formed in it. Here, even if it increases electrification bias and raises the surface potential of a photo conductor 21 to potential V0' from potential V0, latent-image low section potential will not change from potential VON a lot. Therefore, even if it changes electrification bias somewhat, according to the development bias Vb, toner concentration is determined uniquely.

[0057] On the other hand, if the electrostatic latent image LI2 equivalent to the halftone image (the 2nd patch image) PI 2 (drawing 14) which has the 1-dot line DL for every predetermined gap is formed in the front face of the photo conductor 21 charged in homogeneity in surface potential V0, as shown in drawing 16 , the surface potential equivalent to a line location will be greatly lowered to potential (latent-image low section potential) VON, and pectinate square well potential will be formed. Here, if electrification bias is increased like the above and the surface potential of a photo conductor 21 is raised to potential V0' from potential V0, the latent-image low section potential corresponding to each line will change from potential VON to potential VON' a lot. therefore, the toner concentration corresponding to [if electrification bias is changed, it will be interlocked with, and] the development bias Vb -- changing .

[0058] There is little effect electrification bias affects toner concentration when a solid image is formed, and this shows that the image concentration of a solid image can be adjusted by adjusting development bias. That is, when performing development bias calculation processing in which the solid image was used as the 1st patch image like this operation gestalt, accuracy can be asked for the optimal development bias irrespective of the value of electrification bias.

[0059] Moreover, in order to be stabilized and to form an image, it cannot be necessary to say that it is enough just

to have performed adjustment with the highest gradation (maximum density) but, and it is necessary to also perform concentration adjustment of a line drawing image. However, when the halftone image of a line drawing image is used, as shown in drawing 16 , it is influenced with the set point of development bias and electrification bias. So, with this operation gestalt, the optimal development bias is computed previously, and the optimal electrification bias required in order to form the 2nd patch image which consists of a halftone image and to obtain the image concentration of aim concentration is computed, changing electrification bias, where development bias is set as the optimal development bias.

[0060] Furthermore, while only a n line gap isolates two or more 1-dot lines for a line drawing image (the 2nd patch image PI 2) mutually, the reason constituted from a halftone image which comes to carry out parallel arrangement is as follows. That is, although constituting the 2nd patch image PI 2 from a single 1-dot line, and detecting this by the patch sensor PS is also considered in order to adjust the image concentration of a 1-dot line, detection of the image concentration by the patch sensor PS is very low difficult for the image concentration of a 1-dot line. So, by this invention, this problem is solved with constituting a patch image by two or more 1-dot lines.

[0061] Here, when it constitutes a patch image from two or more 1-dot lines, how a 1-dot line is arranged poses a problem. That is, laser beam L irradiated towards a photo conductor 21 from the exposure unit 3 has the optical intensity distribution of a gauss mold as shown in drawing 17 . Although the diameter of a layout spot is adjusted in many cases so that the diameter of a spot in level may correspond to layout resolution about 50% to the maximum of ordinary light reinforcement In this case, when the diameter of an effective exposure spot corresponding to 1 [effective] / e2 as exposure power has the line gap of 1-dot line DL which adjoin from becoming large narrower than the diameter of a layout spot, it is because a toner adheres between lines. [effective] That is, one line, then adjoining effective exposure spots will change the surface potential of overlap and its overlapping fields selectively, and a toner will adhere the line gap n of the adjoining 1-dot line DL (drawing 16 (a)). Therefore, it is necessary to vacate the gap of two lines or more also at the lowest about the line gap of the adjoining 1-dot line DL.

[0062] On the contrary, when a line gap is extended too much, the following problems may arise. That is, the detection sensitivity of the image concentration by the patch sensor PS is closely related to the number of the 1 dot line DL included in the detection field of the sensor PS, and sets concentration change of the 1 dot each line DL to X, the variation delta of the image concentration detected by m, then the patch sensor PS in the number of lines for which close comes to a detection field serves as delta=m-X, and detection sensitivity becomes high according to buildup of the number of lines contained to a detection field. for example, as shown in drawing 18 (a), when the number of lines which goes into the detection field IR of the patch sensor PS in the line gap n1 is five As variation deltaa is shown in this drawing (b) to being deltaa=5 and X, at intervals of [n2 (> n1)] a larger line, the number of lines included in the detection field IR of the patch sensor PS decreases to four, variation deltab is set to deltab=4 and X, and detection sensitivity falls.

[0063] Although various experiments showed that it was necessary to raise the detection sensitivity of the patch sensor PS about single figure in order to perform sufficient concentration adjustment, it is necessary to set the number of lines which goes into the detection field IR for that purpose or more to ten. The number m of the 1-dot line which goes into the detection field IR when magnitude of the detection field IR is set to phi (mm) and R, then a line gap are set as n for the layout resolution of equipment, i.e., the number of dots contained in a unit length (1mm), here is m=phi-R/(1+n).

In order for a next door and this m to be ten or more, it is necessary to satisfy phi-R / (1+n) >=10. And when this inequality is transformed, it is n<= (phi-R -10)/10. — (1)

It becomes. Therefore, the image concentration of the patch image PI 2 is detectable by the detection sensitivity which was excellent by setting up the line gap n so that the above-mentioned inequality (1) may be satisfied.

[0064] Moreover, when reading image concentration by the patch sensor PS, improvement in detection precision aims at by repeating reading actuation, changing a reading location, but when setting the patch image with which parallel arrangement of the 1 dot line is carried out at intervals of the predetermined line as the detection object, the number of the 1 dot line included to a detection field by the difference of a relative location with the detection field of the patch sensor PS and a patch image differs by one at the maximum. When the number of lines of the 1-dot line DL for which close comes to the detection field IR when the detection field IR of the patch sensor PS and a relative location with the patch image PI 2 show drawing 19 (a) is shown in this drawing (b) to being five, the number of lines concerned will become six. For this reason, even if it reads the same patch image PI 2, the image concentration detected shifts, as for that detection gap, a detection gap can become small and they can raise the accuracy of measurement as the number m of m [detection gap (%) =(1/m) x100, however] contained to the number of lines contained to the detection field IR, a next door, and the detection field IR increases.

[0065] Here, in order to perform concentration control of high degree of accuracy, it is necessary to suppress this detection gap within 5%, and it is desirable to set up line several m so that it may become 20 or more. That is, it is necessary to satisfy following inequality phi-R / (1+n) >=20. And when this inequality is transformed, it is n<= (phi-R -20)/20. — It is set to (2). Therefore, a detection gap can be controlled by setting up the line gap n so that the above-mentioned inequality (2) may be satisfied, and the image concentration of the patch image PI 2 can be detected in a further excellent detection precision.

[0066] In addition, this invention can make various change in addition to what was mentioned above unless it is not limited to the above-mentioned operation gestalt and deviated from the meaning. For example, an electrification brush may be used although the electrification roller 22 is used as an electrification means. Moreover, this invention is applicable with a non-contact electrification means also to the image formation equipment which electrifies a

photo conductor 21 instead of contact electrification which contacts conductors, such as an electrification roller and an electrification brush, on a photo conductor front face, and electrifies them in this way.
[0067] Moreover, although the patch image PI 2 is used as the image which arranges and becomes so that it may be the predetermined line gap n and may moreover become parallel to mutual about two or more 1-dot lines DL, as it is shown, for example in drawing 20 with the above-mentioned operation gestalt, it is good also as rectangular grid image PI2' which arranges two or more 1-dot lines DL in the shape of a grid, and becomes. In this case, the number of lines which goes into the detection field IR of the patch sensor PS compared with the patch image PI 2 (drawing 14) which carried out parallel arrangement of the 1-dot line increases, detection sensitivity increases more, and it is more effective to the improvement in precision. Moreover, it also becomes possible to extend the part whose number of lines increased, and the line gap n. The image which stopped being influenced of the concentration nonuniformity of a driving direction easily, and was stabilized more can be detected and controlled by extending the line gap of the direction of vertical scanning especially. Of course, about the grids structure of a patch image, it is not limited to a rectangular grid, and even if it uses various grids, the same effect is acquired.
[0068] Moreover, with the above-mentioned operation gestalt, although it was image formation equipment which can form the color picture which used the toner of four colors, the object for application of this invention is not limited to this, and, naturally can be applied also to the image formation equipment which forms only a monochrome image. Moreover, although the image formation equipment concerning the above-mentioned operation gestalt is a printer which forms the image given through the interface 112 from external devices, such as a host computer, in sheets, such as tracing paper, a transfer paper, a form, and a transparence sheet for OHP, this invention is applicable to the image formation equipment of electrophotography methods, such as a copying machine and facsimile apparatus, at large.
[0069] Moreover, although the optimal development bias and the optimal electrification bias are computed with the above-mentioned operation gestalt based on that detection result while imprinting the toner image on a photo conductor 21 to the medium imprint belt 41 and detecting that image concentration by using this toner image as a patch image This invention is applicable also to the image formation equipment which imprints a toner image to transfer media other than a medium imprint belt (an imprint drum, an imprint belt, an imprint sheet, a medium imprint drum, a medium imprint sheet, a reflective mold record sheet, or penetrable storage sheet), and forms a patch image. Moreover, instead of forming a patch image in a transfer medium, the patch sensor which detects the concentration of the patch image on a photo conductor is formed, and the image concentration of each patch image on a photo conductor is detected, and you may make it compute the optimal development bias and the optimal electrification bias based on that detection result by this patch sensor.
[0070] Moreover, if the optimal development bias and the optimal electrification bias are memorized by RAM127 of the engine controller 12 and the Maine power supply of the main part of image formation equipment is dropped on the above-mentioned operation gestalt Although it is constituted so that it may be judged as the "first time" and processing according to it may be performed in development bias calculation processing and electrification bias calculation processing if the content of storage volatilizes and the Maine power supply is switched on again The optimal development bias and the optimal electrification bias which are called for one by one may be memorized to nonvolatile memory, such as EEPROM, and you may constitute so that processing corresponding to "2nd henceforth" may be performed in development bias calculation processing and electrification bias calculation processing also at the time of the reclosing of the Maine power supply.
[0071] Moreover, although sequential formation of the patch image PI 2 and PI2' is carried out with the above-mentioned operation gestalt, changing the electrification bias given to the electrification roller 22 as a concentration controlling factor Changing light exposure, other concentration controlling factors, for example, development bias, etc. The image concentration of a line drawing image can be stabilized by determining an optimum value required in order to create the patch image which consists of two or more 1-dot lines, to detect the concentration of each patch image also in this case and to obtain aim concentration based on those image concentration.
[0072] Furthermore, although four kinds of bias values are set up in an extensive range and a ** range with the above-mentioned operation gestalt, the number of bias setting out within a range (the number of patch images) is not limited to this, and if it is two or more kinds, it is arbitrary. Moreover, the number of bias setting out may be made different in an extensive range and a ** range, and the number of patch images may be made different.
[0073]
[Example] Next, although the example of this invention is shown, of course, it is also possible for this invention to add and carry out modification suitably [in the range which does not receive a limit according to the following example and may suit the meaning of the account of order] from the first, and each of they is contained in the technical range of this invention.
[0074] At this example, they are the following R:23.6 condition:layout resolution (600DPI)/mm.;
Magnitude of phi:8mm of the detection field IR of the patch sensor PS;
When the patch image was created and the detection voltage of the patch sensor PS was measured, having come out and changing the line gap n, the graph shown in drawing 21 was obtained. The result shown in this graph is well in agreement with the line gap conditions of having explained by the term of the above-mentioned "explanation of the gestalt of operation."
[0075] If the line gap n is set as 1 so that clearly from drawing 21 , it is impossible that is, to distinguish from a solid image, although it is necessary to set the line gap n or more to two in order to avoid the effect of adjoining 1-dot lines.

[0076] It is desirable to set up the line gap n so that the above-mentioned inequality (1) may be satisfied on the other hand, in order to obtain sufficient detection sensitivity, and it is n<= (8x23.6-10) / 10= 17.88 (book) at this example.
It is satisfied, that is, it is desirable to set the line gap n or less to 17. A blank paper image and distinction stop the line gap n sticking or more by 18, and detection of exact image concentration is difficult so that clearly from this point and drawing 21 .
[0077] Moreover, it is desirable to satisfy the above-mentioned inequality (2), in order to suppress a detection gap and to perform highly precise detection, and it is n<= (8x23.6-20) / 20= 8.44 (book) at this example.
It is satisfied, that is, it is desirable to set the line gap n or less to eight, and it is most desirable to set the line gap n as 5 in this example.
[0078]
[Effect of the Invention] As mentioned above, while according to this invention forming the toner image which consists of two or more 1-dot lines by which isolation arrangement was carried out mutually as a patch image and detecting the image concentration of this patch image Since the image concentration of a toner image is adjusted to aim concentration based on the detection result, the line drawing image which consists of a P (P>=2) dot line can stabilize image concentration from the first also about the line drawing image which consists of a 1-dot line.

[Translation done.]

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TECHNICAL FIELD

[The technical field to which invention belongs] This invention relates to the image formation equipment and the image formation method of forming an electrostatic latent image in the front face of this photo conductor, and actualizing said electrostatic latent image with a toner, and forming a toner image with a development means, further, after electrifying the front face of a photo conductor with an electrification means.

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PRIOR ART

[Description of the Prior Art] With this kind of image formation equipment, it may originate in fatigue and aging of a photo conductor and a toner, change of the temperature and humidity in the equipment circumference, etc., and image concentration may change. Then, many technology of adjusting suitably the concentration controlling factor which affects the image concentration of a toner image conventionally, for example, electrification bias, development bias, light exposure, etc., and stabilizing image concentration is proposed. For example, the patch image which comes to output the pair group of a 3-dot line to JP,9-50155,A by invention of a publication every 3 dots was formed in photo conductor drum lifting, and line width of face is detected by reading this patch image by the sensor. And light exposure was adjusted so that desired line width of face might be obtained by controlling laser power based on the line width of face detected in this way, and the line line drawing image of an ideal has been obtained...

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, while forming the toner image which consists of this inventions with two or more 1-dot lines by which isolation arrangement was carried out mutually as a patch image and detecting the image concentration of this patch image, based on that detection result, the image concentration of a toner image is adjusted to aim concentration. Therefore, the line drawing image which consists of a P (P>=2) dot line can stabilize image concentration from the first also about the line drawing image which consists of a 1-dot line.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the bases of a line drawing image are 1-dot lines drawn by one laser beam, and cannot say that the line drawing image was fully adjusted like the conventional example only by controlling the line width of face of two or more dot line.
[0004] This invention is made in view of the above-mentioned technical problem, and it aims at offering the image formation equipment and the image formation method of stabilizing the image concentration of a line drawing image.

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MEANS

[Means for Solving the Problem] An electrification means by which image formation equipment concerning this invention electrifies a front face of a photo conductor, An exposure means to form an electrostatic latent image in a front face of said photo conductor, and a development means to actualize said electrostatic latent image with a toner, and to form a toner image, A toner image formed on said photo conductor by said development means or a toner image with which a transfer medium comes to imprint the toner image concerned is used as a patch image. In order to have a concentration detection means to detect the image concentration, and a control means which adjusts image concentration of a toner image to aim concentration based on a detection result of said concentration detection means and to attain the above-mentioned object, said patch image consists of two or more 1-dot lines by which isolation arrangement was carried out mutually.
[0006] Moreover, after an image formation method concerning this invention electrified a front face of a photo conductor with an electrification means, In order to form an electrostatic latent image in a front face of this photo conductor, to be the image formation method which actualizes said electrostatic latent image with a toner by development means, and forms a toner image further and to attain the above-mentioned object, Changing a concentration controlling factor which affects image concentration of a toner image After carrying out sequential formation of the toner image which consists of two or more 1-dot lines by which isolation arrangement was carried out mutually as a patch image, concentration of each patch image was detected and optimal concentration controlling factor required in order to obtain aim concentration based on those image concentration is determined.
[0007] A toner image which consists of these invention with two or more 1-dot lines by which isolation arrangement was carried out mutually is formed as a patch image. And while image concentration of this patch image is detected, based on that detection result, stabilization of image concentration of a line drawing image with which image concentration of a toner image is adjusted to aim concentration, and consists of a 1-dot line is attained.
[0008] In addition, about adjustment of image concentration, it is good in a line as follows, for example. That is, after carrying out sequential formation of two or more toner images as a patch image, changing electrification bias given to an electrification means as a concentration controlling factor which affects image concentration of a toner image, decision **** is good in the optimal electrification bias required in order to detect concentration of each patch image and to obtain aim concentration based on those image concentration.
[0009] Moreover, in case electrification bias is changed, it is desirable to make it increase gradually. It is because a direction changed in the buildup direction rather than the reduction direction is excellent in respect of the responsibility of a power supply when changing electrification bias in step. Thus, contact electrification can be used as a concrete means to change electrification bias gradually.
[0010] Moreover, about two or more 1-dot lines which constitute a patch image, it is almost parallel to mutual and it is desirable for adjoining 1-dot lines to isolate only a n line gap (integer of n>=2) moreover. Moreover, detection area size of a concentration detection means is set to phi, it is desirable to set R, then the adjoining line gap n of 1-dot lines as n<= (phi-R -10) / 10 for resolution of image formation equipment, and it is more more suitable still to set it as n<= (phi-R -20) / 20. Thus, a reason with desirable setting up a upper limit and a lower limit of the line gap n is explained in full detail by next "gestalt of implementation of invention", and term of an "example."
[0011] Furthermore, a patch image may be constituted from a grid image which comes to arrange two or more 1-dot lines in the shape of a grid, the number of lines which goes into a detection field of a concentration detection means compared with a patch image which carried out parallel arrangement of two or more 1-dot lines in this case increases, and detection sensitivity increases more.
[0012]
[Embodiment of the Invention] A. The whole image formation equipment block diagram 1 is drawing showing the operation gestalt of 1 of the image formation equipment concerning this invention. Moreover, drawing 2 is the block diagram showing the electric configuration of the image formation equipment of drawing 1 . This image formation equipment is yellow (Y), cyanogen (C), a Magenta (M), and equipment that piles up the toner of four colors of black (K) and forms a monochrome image, using only the toner of black (K) in forming a full color image ****. With this image formation equipment, if a picture signal is given to the Maine controller 11 of a control unit 1 from external devices, such as a host computer, according to the command from this Maine controller 11, the engine controller 12 will control each part of the engine section E, and the image corresponding to a picture signal will be formed in Sheet S.
[0013] A toner image can be formed in the photo conductor 21 of the image support unit 2 in this engine section E. That is, the image support unit 2 is equipped with the pivotable photo conductor 21 in the direction of an arrow head

of drawing 1 , and the electrification roller 22 as an electrification means, the development counters 23Y, 23C, 23M, and 23K as a development means, and the cleaning section 24 are further arranged along the hand of cut, respectively around the photo conductor 21. High tension is impressed from the electrification bias generating section 121, and the electrification roller 22 electrifies a peripheral face in homogeneity in contact with the peripheral face of a photo conductor 21.

[0014] And laser beam L is irradiated from the exposure unit 3 towards the peripheral face of the photo conductor 21 charged with this electrification roller 22. As shown in drawing 2 , it connects with the picture signal change over section 122 electrically, and this exposure unit 3 carries out scan exposure of the laser beam L on a photo conductor 21 according to the picture signal given through this picture signal change over section 122, and forms the electrostatic latent image corresponding to a picture signal on a photo conductor 21. For example, when the picture signal change over section 122 has flowed with the patch creation module 124 based on the command from CPU123 of the engine controller 12, the patch picture signal outputted from the patch creation module 124 is given to the exposure unit 3, and a patch latent image is formed. On the other hand, when the picture signal change over section 122 has flowed with CPU111 of the Maine controller 11, according to the picture signal given through the interface 112 from external devices, such as a host computer, scan exposure of the laser beam L is carried out on a photo conductor 21, and the electrostatic latent image corresponding to a picture signal is formed on a photo conductor 21.

[0015] In this way, toner development of the formed electrostatic latent image is carried out by the development section 23. That is, in this operation gestalt, development counter 23K for development counter 23M and blacks development counter 23Y for yellow, development counter 23C for cyanogen, and for Magentas are arranged along with the photo conductor 21 as the development section 23 in this sequence. These development counters 23Y, 23C, 23M, and 23K While it is constituted free [attachment and detachment] to the photo conductor 21, respectively and the development counter of one of the four above-mentioned development counters 23Y, 23M, 23C, and 23B contacts a photo conductor 21 selectively according to the command from the engine controller 12 By the development bias generating section 125, high tension gives the toner of the color impressed and chosen to the front face of a photo conductor 21, and actualizes the electrostatic latent image on a photo conductor 21.

[0016] the toner image developed in the development section 23 -- the object for blacks -- it imprints primarily on the medium imprint belt 41 of the imprint unit 4 in the primary imprint field R1 located between development counter 23K and the cleaning section 24. In addition, the structure of this imprint unit 4 is explained in full detail later.

[0017] Moreover, it is failed after a primary imprint for the cleaning section 24 to be arranged from the primary imprint field R1 in the location which went to the hoop direction (the direction of an arrow head of drawing 1), and to scratch the toner which is carrying out residual adhesion to the peripheral face of a photo conductor 21.

[0018] Next, the configuration of the imprint unit 4 is explained. The imprint unit 4 is equipped with rollers 42-47, the medium imprint belt 41 over which each [these] rollers 42-47 were built, and the secondary imprint roller 48 which imprints secondarily the medium toner image imprinted by this medium imprint belt 41 on Sheet S with this operation gestalt. Primary imprint voltage is impressed to this medium imprint belt 41 from the imprint bias generating section 126. And in imprinting a color picture on Sheet S, while piling up the toner image of each color formed on a photo conductor 21 on the medium imprint belt 41 and forming a color image, by the feed section 63 of the feeding-and-discarding paper unit 6, Sheet S is picked out from a cassette 61, a detachable tray 62, or a duplication cassette (graphic display abbreviation), and it conveys to the secondary imprint field R2. And a color image is secondarily imprinted on this sheet S, and a FURU color picture is obtained. Moreover, in imprinting a monochrome image on Sheet S, only a black toner image is formed on the medium imprint belt 41 on a photo conductor 21, and it imprints on the sheet S conveyed to the secondary imprint field R2 like the case of a color picture, and obtains a monochrome image.

[0019] In addition, about the toner which is carrying out residual adhesion, it is removed by the peripheral face of the medium imprint belt 41 with a belt cleaner 49 after a secondary imprint. On both sides of the medium imprint belt 41, this belt cleaner 49 counters with a roller 46, is arranged, and a cleaner blade contacts to the medium imprint belt 41 to suitable timing, and it fails to scratch the toner which is carrying out residual adhesion to that peripheral face.

[0020] Moreover, while the patch sensor PS for detecting the concentration of the patch image formed in the peripheral face of the medium imprint belt 41 as mentions later near the roller 43 is arranged, the reading sensor RS for a synchronization for detecting the criteria location of the medium imprint belt 41 is arranged.

[0021] It returns to drawing 1 and configuration explanation of the engine section E is continued. The sheet S by which the toner image was imprinted with the imprint unit 4 is conveyed by the fixation unit 5 arranged in the downstream of the secondary imprint field R2 by the feed section 63 of the feeding-and-discarding paper unit 6 in accordance with the predetermined feed path (two-dot chain line), and is fixed to Sheet S in the toner image on the sheet S conveyed. And the sheet S concerned is further conveyed by the delivery unit 64 in accordance with the feed path 630.

[0022] While this delivery unit 64 has two delivery paths 641a and 641b and one delivery path 641a is prolonged in a standard paper output tray from the fixation unit 5, delivery path 641b of another side is mostly prolonged between the re-feeding section 66 and a multi-bottle unit in parallel with delivery path 641a. In accordance with these delivery paths 641a and 641b, 3 sets of roller pair 642-644 are prepared, turn the sheet [finishing / fixation] S to a standard paper output tray and multi-bottle unit side, and it discharges, or in order to form an image also in the another side side side, it conveys to the re-feeding section 66 side.

[0023] the sheet S by which reversal conveyance has been carried out as mentioned above from the delivery unit 64 as this re-feeding section 66 is shown in drawing 1 — the re-feeding path 664 (two-dot chain line) — meeting — the gate roller pair of the feed section 63 — three which conveys to 637 and were arranged in accordance with the re-feeding path 664 — re— it consists of feed roller pair 661-663. thus, the sheet S conveyed from the delivery unit 64 — the re-feeding path 664 — meeting — a gate roller pair — by returning to 637, in the feed section 63, the non-image formation side of Sheet S turns to the medium imprint belt 41, and the secondary imprint of an image of it is attained in the field concerned.
[0024] In addition, in order to memorize the image with which the sign 113 was given through the interface 112 in drawing 2 from external devices, such as a host computer, it is the image memory established in the Maine controller 11, and a sign 127 is RAM for memorizing temporarily the result of an operation in control data and CPU123 for controlling the engine section E etc., and a sign 128 is ROM which memorizes the operation program performed by CPU123 further.
[0025] B. Explain concentration adjustment actuation of the concentration adjustment actuation in image formation equipment, next an image [in / it is constituted as mentioned above and / image formation equipment].
[0026] Drawing 3 is a flow chart which shows the concentration adjustment actuation in the image formation equipment of drawing 1 . With this image formation equipment, as shown in this drawing, it is judged whether it is necessary to perform concentration adjustment actuation at step S1, and to carry out updating setting out of development bias and the electrification bias. For example, if it will be in the condition that an image can be formed after switching on the Maine power supply of the main part of image formation equipment, you may constitute so that bias setting out may be started. Moreover, continuous duty time amount is measured and you may make it start bias setting out every several hours by the timer (graphic display abbreviation) formed in the main part of equipment.
[0027] If it is judged as "YES" at this step S1 and bias setting out is started, the optimal development bias will be computed by performing steps S2 and S3, and it will be set up as development bias (step S4). Moreover, the optimal electrification bias is computed by performing step S5 following it, and it is set up as electrification bias (step S6). In this way, optimization of development bias and electrification bias is performed. Hereafter, the content of development bias calculation processing (step S3) and electrification bias calculation processing (step S5) is explained to details, respectively.
[0028] B-1. Development bias calculation processing drawing 4 is a flow chart which shows the content of development bias calculation processing of drawing 3 . In this development bias calculation processing (step S3), after the Maine power supply of the main part of image formation equipment is switched on first, it judges whether it is being carried out to the beginning, or 2nd henceforth (step S301). And when it is judged as the first time, they are all colors (with this operation gestalt). It progresses to step S312, after setting up yellow (Y), cyanogen (C), a Magenta (M), and the purport that forms a patch image about four colors of black (K) (step S311). In a comparatively large range And changing development bias gradually at a comparatively large gap, two or more patch images are formed and it asks for development bias required in order to obtain the optimal image concentration based on the concentration of each patch image provisionally. It explains in full detail, reaching and carrying out drawing 6 reference of drawing 5 about the content of processing.
[0029] Drawing 5 is a flow chart which shows the content of bias calculation processing in the extensive range of drawing 4 . Moreover, drawing 6 is the mimetic diagram showing the content of processing of drawing 5 , and the content of bias calculation processing in the ** range explained later. In this calculation processing, the color which creates a patch image is set to the first color, for example, yellow, (step S312a). And it is the default which set up electrification bias at step S2 beforehand, and development bias is set as four steps at a comparatively large gap (the 1st gap) within the limits of an extensive range (step S312b). For example, with this operation gestalt, by the development bias generating section 125, the whole adjustable band (Vb01-Vb10) of the development bias which can be supplied to the development section 23 was set up as an extensive range, and Vb01, Vb04, Vb07, and Vb10 are set up as development bias. [four / of the points in this extensive range (Vb01-Vb10)] Thus, the 1st gap W1 is set to W1=Vb10-Vb07=Vb07-Vb04=Vb04-Vb01 with this operation gestalt.
[0030] As sequential formation of the four yellow solid images (drawing 7) is carried out on a photo conductor by such bias setting out and it is further shown in drawing 8 (a), these are imprinted to the peripheral face of the medium imprint belt 41, and the 1st patch image PI 1 is formed (step S312c). In addition, with this operation gestalt, although the 1st patch image PI 1 is used as the solid image, that reason is explained in full detail later.
[0031] While judging whether the following step S312d created the patch image about all patch creation colors and being judged as "NO" As a patch creation color is set as the following color (step S312e), step S312b and S312c are repeated and it is shown in drawing 8 (b) - (d), cyanogen (C), The 1st patch image PI 1 is further formed on the peripheral face of the medium imprint belt 41 in order of a Magenta (M) and black (K).
[0032] On the other hand, if it is judged as "YES" by step S312d, the image concentration of the patch image PI 1 of 16 (= four-kind x4 color) individuals will be measured by the patch sensor PS (step S 312f). With this operation gestalt, after forming the patch image PI 1 about all patch creation colors, the image concentration of the patch image PI 1 is measured collectively, but whenever it forms the patch image PI 1 of each patch creation color, it may be made to carry out sequential measurement of the image concentration of the patch image PI 1. It is [in / about this point / next bias calculation processing (drawing 9 , drawing 10 , and drawing 12)] the same.
[0033] It can come, and is alike, then asks for the development bias corresponding to aim concentration by step S312g, and it is temporarily memorized to RAM127, using this as provisional bias. Here, when the measurement

result (image concentration) is in agreement with aim concentration, it can ask for provisional bias by linear interpolation, equalization processing, etc. based on the data D (Vb04) and D (Vb07) which sandwiches aim concentration for the development bias corresponding to the image concentration as it shows in drawing 6 (b), provisional bias then in are good and not being in agreement.

[0034] In this way, if provisional bias can be found, bias calculation processing (1) in the ** range of drawing 4 will be performed. Drawing 9 is a flow chart which shows the content of bias calculation processing (1) in the ** range of drawing 4 . In this calculation processing, the color which creates a patch image is set to the first color, for example, yellow, like previous calculation processing (step S312) (step S313a). And development bias is set as four steps at a gap (the 2nd gap) narrower than the 1st gap W1 within the limits of a ** range containing the provisional bias for which is the default which set up electrification bias at step S2 beforehand, and it asked at step S312 (step S313b). for example, — this operation gestalt — about [of the adjustable band (Vb01-Vb10) of development bias] — one third is set up as a ** range, and as provisional bias shows drawing 6 (b), in being between the development bias Vb05 and Vb06, it has set up four Vb04, Vb05, Vb06, and Vb07 as development bias (this drawing (c)). Thus, the 2nd gap W2 is set to W2=Vb07-Vb06=Vb06-Vb05=Vb05-Vb04 with this operation gestalt.

[0035] As sequential formation of the four yellow solid images (drawing 7) is carried out on a photo conductor by such bias setting out and it is further shown in drawing 8 (a), these are imprinted to the peripheral face of the medium imprint belt 41, and the 1st patch image PI 1 is formed (step S313c). And until it judges that the patch image was created about all patch creation colors by step S313d as well as previous calculation processing (step S312) A patch creation color is set as the following color (step S313e), step S313b and S313c are repeated, and the 1st patch image PI 1 is further formed on the peripheral face of the medium imprint belt 41 in order of cyanogen (C), a Magenta (M), and black (K).

[0036] In this way, if the patch image PI 1 of 16 (= four-kind x4 color) individual is formed in the medium imprint belt 41, the image concentration of each patch image will be measured by the patch sensor PS (step S 313f). It can come, and is alike, then asks for the development bias corresponding to aim concentration by step S313g. Here, when the measurement result (image concentration) is in agreement with aim concentration, it can ask for the optimal development bias by the linear interpolation based on the data D (Vb05) and D (Vb06) which sandwiches aim concentration for the development bias corresponding to the image concentration as it shows in drawing 6 (d), provisional bias then in are good and not being in agreement, etc.

[0037] In this way, about the called-for optimal development bias, it memorizes to RAM127 (step S302 of drawing 4), and in the time of calculation of the electrification bias mentioned later, or the usual image formation processing, it reads from RAM127 and sets up as development bias.

[0038] As mentioned above, with this operation gestalt, it is an extensive range, and asks for development bias required in order to obtain the image of aim concentration at the 1st gap W1 provisionally, and it is the ** range which contains provisional bias further, and asks for development bias required in order to set up development bias at the moreover more fine gap (the 2nd gap) W2 and to obtain aim concentration, and this is eventually made into the optimal development bias. Therefore, the following effects are acquired.

[0039] For example, when the Maine power supply of the main part of image formation equipment is switched on, the property of a photo conductor or a toner, the temperature and humidity of the equipment circumference, etc. cannot expect at all how it is changing, but after setting up development bias so that the whole development bias adjustable band (Vb01-Vb10) may be covered, they need to form a patch image, and need to determine the optimal development bias. Then, it is also possible to divide a development bias adjustable band (Vb01-Vb10) into two or more ** range, to perform the above-mentioned bias calculation processing (1) and same processing in each ** range, and to ask for the optimal development bias. However, in this example of a comparison, the number of steps increases in proportion to the number of partitions, and there is a problem that calculation of the optimal development bias will take time amount. On the contrary, if the number of partitions is lessened, another problem that breadth, consequently calculation precision of the optimal development bias cannot fall, and the bias gap within one division range of what can solve the above-mentioned problem cannot adjust image concentration to aim concentration rather than the 2nd bias gap W2 at accuracy will arise.

[0040] On the other hand, with this operation gestalt, after asking for near development bias provisionally by bias calculation processing (step S312) in an extensive range as mentioned above, it is a ** range near the provisional bias further, and since the optimal development bias is computed by moreover changing development bias at the fine gap (the 2nd gap) W2, compared with the above-mentioned example of a comparison, it is a short time and, moreover, high degree of accuracy can be asked for the optimal development bias.

[0041] By the way, although the optimal electrification bias and the optimal development bias change according to fatigue, aging, etc. of a photo conductor and a toner, the change has a certain amount of continuity. Therefore, when repeating and performing adjustment processing of image concentration, the optimal development bias can be expected based on the last image density measurement result (step S 313f, step S322f, S510 which are mentioned later, etc.). so, in the development bias calculation processing (step S3) concerning this operation gestalt When it judges that it is 2nd henceforth, that is, is judged as "2nd henceforth" at step S301 of drawing 4 after the Maine power supply of the main part of image formation equipment was switched on all colors (this operation gestalt — yellow (Y), cyanogen (C), and a Magenta (M) —) After setting up the purport which forms a patch image about four colors of black (K) (step S321), it is asking for the optimal development bias, without progressing to step S322, performing bias calculation processing (2) in a ** range, and asking for provisional bias. Hereafter, it explains, referring to drawing 10 about the content of processing.

[0042] Drawing 10 is a flow chart which shows the content of bias calculation processing (2) in the ** range of drawing 4 . Moreover, drawing 11 is the mimetic diagram showing the content of processing of drawing 10 . The point that this calculation processing is greatly different from bias calculation processing (1) in the ** range explained previously While setting electrification bias as a default in calculation processing (1) of drawing 9 As opposed to that which has set up four kinds of development bias in a ** range based on provisional bias (step S313b) While setting up the optimal electrification bias which is called for by the last image density measurement in this bias calculation processing (2), and is memorized by RAM127 as electrification bias It is the point of having set up four kinds of development bias in a ** range based on the optimal development bias memorized by this RAM127 (step S322b), and other configurations are the same. Therefore, it omits about explanation of the same configuration here.
[0043] Thus, since are a ** range, four kinds of development bias is moreover set up at the 2nd gap using the last image density measurement result (the last optimal development bias), the patch image of each color is formed, without asking for provisional bias and he is trying to ask for the optimal development bias about concentration adjustment actuation of the 2nd henceforth, it can ask for the optimal development bias further further in a short time. In addition, about the optimal development bias called for in this way, it rewrites with the optimal development bias already memorized by RAM127, and updates to the newest thing (step S302 of drawing 4).
[0044] In this way, if the optimal development bias can be found, return and the optimal development bias computed as mentioned above will be read from RAM127 to drawing 3 , and this will be set up as development bias. And the optimal electrification bias is computed (step S5), and it is set up as electrification bias (step S6).
[0045] B-2. Optimal electrification bias calculation processing drawing 12 is a flow chart which shows the content of electrification bias calculation processing of drawing 3 . Moreover, drawing 13 is the mimetic diagram showing the content of processing of drawing 10 . in this electrification bias calculation processing (step S5), after setting up the purport which forms a patch image about all colors (this operation gestalt -- four colors of yellow (Y), cyanogen (C), a Magenta (M), and black (K)) (step S501), the color which progresses to step S502 and creates the 2nd patch image is set to the first color, for example, yellow, (step S501).
[0046] And after the Maine power supply of the main part of image formation equipment is switched on like the case of development bias calculation processing, when it judges whether it is that electrification bias calculation processing is performed first or 2nd henceforth (step S503) and is judged as the first time, step S504 is performed, and when it is judged that it is 2nd henceforth, step S505 is performed.
[0047] In this step S504, electrification bias is set as four steps at a comparatively narrow gap (the 3rd gap) within the limits of a ** range, including the default beforehand set up at step S2. On the other hand, in step S505, electrification bias is set as four steps at a comparatively narrow gap (the 3rd gap) within the limits of a ** range based on the last image density measurement result (the optimal electrification bias). Thus, only calculation processing in a ** range is performed, without electrification bias calculation processing performing calculation processing in an extensive range unlike development bias calculation processing. in addition -- this operation gestalt -- about [of the adjustable band (Va01-Va10) of electrification bias] -- as one third is set up as a ** range, for example, a default or the last optimal electrification bias shows drawing 13 (a), in being between the electrification bias Va05 and Vb06, it has set up four Va04, Va05, Va06, and Va07 as electrification bias. Thus, 3rd gap W3 is set to W3=Va07-Va06=Va06-Va05=Va05-Va04 with this operation gestalt.
[0048] If four kinds of electrification bias is set up about a yellow color as mentioned above, increasing electrification bias gradually from the lowest value Va04, sequential formation of the halftone image (drawing 14) of each yellow will be carried out on a photo conductor, these will be imprinted to the peripheral face of the medium imprint belt 41, and the 2nd patch image PI 2 will be formed (drawing 8 (a): step S506). Thus, it is because the direction changed in the buildup direction rather than the reduction direction is excellent in respect of the responsibility of a power supply when changing electrification bias in step to increase electrification bias gradually. In addition, although the 2nd patch image PI 2 is used as the halftone image which comes to carry out parallel arrangement with this operation gestalt while only a five-line gap (n= 5) isolates two or more 1-dot lines mutually, the 1st patch image is combined with the reason used as the solid image about that reason, and it explains in full detail later.
[0049] While judging whether the following step S507 created the 2nd patch image about all patch creation colors and being judged as "NO" As a patch creation color is set as the following color (step S508), steps S503-S507 are repeated and it is shown in drawing 8 (b) - (d), cyanogen (C), The 2nd patch image PI 2 is further formed on the peripheral face of the medium imprint belt 41 in order of a Magenta (M) and black (K).
[0050] On the other hand, if it is judged as "YES" at step S507, the image concentration of the patch image PI 2 of 16 (= four-kind x4 color) individuals will be measured by the patch sensor PS (step S509). Moreover, it can come, and is alike, then asks for the electrification bias corresponding to aim concentration at step S550 (step S510), and memorizes to RAM127 by making this into the optimal electrification bias (step S511). Here, when the measurement result (image concentration) is in agreement with aim concentration, it can ask for the optimal electrification bias by the linear interpolation based on the data D (Va05) and D (Va06) which sandwiches aim concentration for the electrification bias corresponding to the image concentration as it shows in drawing 13 (b), the optimal electrification bias then in are good and not being in agreement, etc.
[0051] In this way, if the optimal electrification bias can be found, in addition to having already set up the optimal development bias as development bias, the optimal electrification bias computed as mentioned above will be read from RAM127, and this will be set up as electrification bias. And if image formation is performed under these setting out, an image can be formed by aim concentration and stabilization of image concentration can be attained.

[0052] As mentioned above, according to this operation gestalt, in quest of the optimal electrification bias and the optimal development bias, image concentration can be adjusted to aim concentration, and image concentration can be stabilized. Each patch image PI 2 is especially constituted from this operation gestalt with two or more 1-dot lines by which isolation arrangement was carried out mutually. Since the image concentration of each patch image PI 2 is detected and the image concentration of a toner image is adjusted to aim concentration based on the detection result, From the first, also about the line drawing image which consists of a 1-dot line, stabilization of image concentration can be attained, by suitable image concentration, a precise image is also stabilized and the line drawing image which consists of a P (P>=2) dot line can form it.
[0053] Moreover, about the optimal electrification bias, since it performs after setting up the optimal development bias called for by processing just before the calculation processing as development bias, high degree of accuracy can be asked for the optimal electrification bias.
[0054] Moreover, in development bias calculation processing of the 2nd henceforth, and electrification bias calculation processing, since bias calculation is performed based on the last image density measurement result (the optimal electrification bias and the optimal development bias), it is a short time and can ask for the newest optimal electrification bias and the newest optimal development bias with a sufficient precision.
[0055] C. The reason is as follows, although the halftone image which comes to carry out parallel arrangement is used as the 2nd patch image by electrification bias calculation processing while only a n line gap isolates two or more 1-dot lines mutually while using a solid image as the 1st patch image by development bias calculation processing with the above-mentioned operation gestalt by the way about a patch image.
[0056] If the electrostatic latent image LI1 equivalent to the solid image (the 1st patch image) PI 1 (drawing 7) is formed in the front face of the photo conductor 21 charged in homogeneity in surface potential V0, as shown in drawing 15 , the surface potential equivalent to the electrostatic latent image LI1 will be greatly lowered to it to potential (latent-image low section potential) VON, and square well potential will be formed in it. Here, even if it increases electrification bias and raises the surface potential of a photo conductor 21 to potential V0' from potential V0, latent-image low section potential will not change from potential VON a lot. Therefore, even if it changes electrification bias somewhat, according to the development bias Vb, toner concentration is determined uniquely.
[0057] On the other hand, if the electrostatic latent image LI2 equivalent to the halftone image (the 2nd patch image) PI 2 (drawing 14) which has the 1-dot line DL for every predetermined gap is formed in the front face of the photo conductor 21 charged in homogeneity in surface potential V0, as shown in drawing 16 , the surface potential equivalent to a line location will be greatly lowered to potential (latent-image low section potential) VON, and pectinate square well potential will be formed. Here, if electrification bias is increased like the above and the surface potential of a photo conductor 21 is raised to potential V0' from potential V0, the latent-image low section potential corresponding to each line will change from potential VON to potential VON' a lot. therefore, the toner concentration corresponding to [if electrification bias is changed, it will be interlocked with, and] the development bias Vb -- changing .
[0058] There is little effect electrification bias affects toner concentration when a solid image is formed, and this shows that the image concentration of a solid image can be adjusted by adjusting development bias. That is, when performing development bias calculation processing in which the solid image was used as the 1st patch image like this operation gestalt, accuracy can be asked for the optimal development bias irrespective of the value of electrification bias.
[0059] Moreover, in order to be stabilized and to form an image, it cannot be necessary to say that it is enough just to have performed adjustment with the highest gradation (maximum density) but, and it is necessary to also perform concentration adjustment of a line drawing image. However, when the halftone image of a line drawing image is used, as shown in drawing 16 , it is influenced with the set point of development bias and electrification bias. So, with this operation gestalt, the optimal development bias is computed previously, and the optimal electrification bias required in order to form the 2nd patch image which consists of a halftone image and to obtain the image concentration of aim concentration is computed, changing electrification bias, where development bias is set as the optimal development bias.
[0060] Furthermore, while only a n line gap isolates two or more 1-dot lines for a line drawing image (the 2nd patch image PI 2) mutually, the reason constituted from a halftone image which comes to carry out parallel arrangement is as follows. That is, although constituting the 2nd patch image PI 2 from a single 1-dot line, and detecting this by the patch sensor PS is also considered in order to adjust the image concentration of a 1-dot line, detection of the image concentration by the patch sensor PS is very low difficult for the image concentration of a 1-dot line. So, by this invention, this problem is solved with constituting a patch image by two or more 1-dot lines.
[0061] Here, when it constitutes a patch image from two or more 1-dot lines, how a 1-dot line is arranged poses a problem. That is, laser beam L irradiated towards a photo conductor 21 from the exposure unit 3 has the optical intensity distribution of a gauss mold as shown in drawing 17 . Although the diameter of a layout spot is adjusted in many cases so that the diameter of a spot in level may correspond to layout resolution about 50% to the maximum of ordinary light reinforcement In this case, when the diameter of an effective exposure spot corresponding to 1 [effective] / e2 as exposure power has the line gap of 1-dot line DL which adjoin from becoming large narrower than the diameter of a layout spot, it is because a toner adheres between lines. [effective] That is, one line, then adjoining effective exposure spots will change the surface potential of overlap and its overlapping fields selectively, and a toner will adhere the line gap n of the adjoining 1-dot line DL (drawing 16 (a)). Therefore, it is necessary to vacate the gap of two lines or more also at the lowest about the line gap of the adjoining 1-dot line DL.

[0062] On the contrary, when a line gap is extended too much, the following problems may arise. That is, the detection sensitivity of the image concentration by the patch sensor PS is closely related to the number of the 1 dot line DL included in the detection field of the sensor PS, and sets concentration change of the 1 dot each line DL to X, the variation delta of the image concentration detected by m, then the patch sensor PS in the number of lines for which close comes to a detection field serves as delta=m-X, and detection sensitivity becomes high according to buildup of the number of lines contained to a detection field. for example, as shown in drawing 18 (a), when the number of lines which goes into the detection field IR of the patch sensor PS in the line gap n1 is five As variation deltaa is shown in this drawing (b) to being deltaa=5 and X, at intervals of [n2 (> n1)] a larger line, the number of lines included in the detection field IR of the patch sensor PS decreases to four, variation deltab is set to deltab=4 and X, and detection sensitivity falls.
[0063] Although various experiments showed that it was necessary to raise the detection sensitivity of the patch sensor PS about single figure in order to perform sufficient concentration adjustment, it is necessary to set the number of lines which goes into the detection field IR for that purpose or more to ten. The number m of the 1-dot line which goes into the detection field IR when magnitude of the detection field IR is set to phi (mm) and R, then a line gap are set as n for the layout resolution of equipment, i.e., the number of dots contained in a unit length (1mm), here is m=phi-R/(1+n).
In order for a next door and this m to be ten or more, it is necessary to satisfy phi-R / (1+n) >=10. And when this inequality is transformed, it is n<= (phi-R -10)/10. -- (1)
It becomes. Therefore, the image concentration of the patch image PI 2 is detectable by the detection sensitivity which was excellent by setting up the line gap n so that the above-mentioned inequality (1) may be satisfied.
[0064] Moreover, when reading image concentration by the patch sensor PS, improvement in detection precision aims at by repeating reading actuation, changing a reading location, but when setting the patch image with which parallel arrangement of the 1 dot line is carried out at intervals of the predetermined line as the detection object, the number of the 1 dot line included to a detection field by the difference of a relative location with the detection field of the patch sensor PS and a patch image differs by one at the maximum. When the number of lines of the 1-dot line DL for which close comes to the detection field IR when the detection field IR of the patch sensor PS and a relative location with the patch image PI 2 show drawing 19 (a) is shown in this drawing (b) to being five, the number of lines concerned will become six. For this reason, even if it reads the same patch image PI 2, the image concentration detected shifts, as for that detection gap, a detection gap can become small and they can raise the accuracy of measurement as the number m of m [detection gap (%) =(1/m) x100, however] contained to the number of lines contained to the detection field IR, a next door, and the detection field IR increases.
[0065] Here, in order to perform concentration control of high degree of accuracy, it is necessary to suppress this detection gap within 5%, and it is desirable to set up line several m so that it may become 20 or more. That is, it is necessary to satisfy following inequality phi-R / (1+n) >=20. And when this inequality is transformed, it is n<= (phi-R -20)/20. -- It is set to (2). Therefore, a detection gap can be controlled by setting up the line gap n so that the above-mentioned inequality (2) may be satisfied, and the image concentration of the patch image PI 2 can be detected in a further excellent detection precision.
[0066] In addition, this invention can make various change in addition to what was mentioned above unless it is not limited to the above-mentioned operation gestalt and deviated from the meaning. For example, an electrification brush may be used although the electrification roller 22 is used as an electrification means. Moreover, this invention is applicable with a non-contact electrification means also to the image formation equipment which electrifies a photo conductor 21 instead of contact electrification which contacts conductors, such as an electrification roller and an electrification brush, on a photo conductor front face, and electrifies them in this way.
[0067] Moreover, although the patch image PI 2 is used as the image which arranges and becomes so that it may be the predetermined line gap n and may moreover become parallel to mutual about two or more 1-dot lines DL, as it is shown, for example in drawing 20 with the above-mentioned operation gestalt, it is good also as rectangular grid image PI2' which arranges two or more 1-dot lines DL in the shape of a grid, and becomes. In this case, the number of lines which goes into the detection field IR of the patch sensor PS compared with the patch image PI 2 (drawing 14) which carried out parallel arrangement of the 1-dot line increases, detection sensitivity increases more, and it is more effective to the improvement in precision. Moreover, it also becomes possible to extend the part whose number of lines increased, and the line gap n. The image which stopped being influenced of the concentration nonuniformity of a driving direction easily, and was stabilized more can be detected and controlled by extending the line gap of the direction of vertical scanning especially. Of course, about the grids structure of a patch image, it is not limited to a rectangular grid, and even if it uses various grids, the same effect is acquired.
[0068] Moreover, with the above-mentioned operation gestalt, although it was image formation equipment which can form the color picture which used the toner of four colors, the object for application of this invention is not limited to this, and, naturally can be applied also to the image formation equipment which forms only a monochrome image. Moreover, although the image formation equipment concerning the above-mentioned operation gestalt is a printer which forms the image given through the interface 112 from external devices, such as a host computer, in sheets, such as tracing paper, a transfer paper, a form, and a transparence sheet for OHP, this invention is applicable to the image formation equipment of electrophotography methods, such as a copying machine and facsimile apparatus, at large.
[0069] Moreover, although the optimal development bias and the optimal electrification bias are computed with the above-mentioned operation gestalt based on that detection result while imprinting the toner image on a photo

conductor 21 to the medium imprint belt 41 and detecting that image concentration by using this toner image as a patch image This invention is applicable also to the image formation equipment which imprints a toner image to transfer media other than a medium imprint belt (an imprint drum, an imprint belt, an imprint sheet, a medium imprint drum, a medium imprint sheet, a reflective mold record sheet, or penetrable storage sheet), and forms a patch image. Moreover, instead of forming a patch image in a transfer medium, the patch sensor which detects the concentration of the patch image on a photo conductor is formed, and the image concentration of each patch image on a photo conductor is detected, and you may make it compute the optimal development bias and the optimal electrification bias based on that detection result by this patch sensor.

[0070] Moreover, if the optimal development bias and the optimal electrification bias are memorized by RAM127 of the engine controller 12 and the Maine power supply of the main part of image formation equipment is dropped on the above-mentioned operation gestalt Although it is constituted so that it may be judged as the "first time" and processing according to it may be performed in development bias calculation processing and electrification bias calculation processing if the content of storage volatilizes and the Maine power supply is switched on again The optimal development bias and the optimal electrification bias which are called for one by one may be memorized to nonvolatile memory, such as EEPROM, and you may constitute so that processing corresponding to "2nd henceforth" may be performed in development bias calculation processing and electrification bias calculation processing also at the time of the reclosing of the Maine power supply.

[0071] Moreover, although sequential formation of the patch image PI 2 and PI2' is carried out with the above-mentioned operation gestalt, changing the electrification bias given to the electrification roller 22 as a concentration controlling factor Changing light exposure, other concentration controlling factors, for example, development bias, etc. The image concentration of a line drawing image can be stabilized by determining an optimum value required in order to create the patch image which consists of two or more 1-dot lines, to detect the concentration of each patch image also in this case and to obtain aim concentration based on those image concentration.

[0072] Furthermore, although four kinds of bias values are set up in an extensive range and a ** range with the above-mentioned operation gestalt, the number of bias setting out within a range (the number of patch images) is not limited to this, and if it is two or more kinds, it is arbitrary. Moreover, the number of bias setting out may be made different in an extensive range and a ** range, and the number of patch images may be made different.

[Translation done.]

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EXAMPLE

[Example] Next, although the example of this invention is shown, of course, it is also possible for this invention to add and carry out modification suitably [in the range which does not receive a limit according to the following example and may suit the meaning of the account of order] from the first, and each of they is contained in the technical range of this invention.
[0074] At this example, they are the following R:23.6 condition:layout resolution (600DPI)/mm.;
Magnitude of phi:8mm of the detection field IR of the patch sensor PS;
When the patch image was created and the detection voltage of the patch sensor PS was measured, having come out and changing the line gap n, the graph shown in drawing 21 was obtained. The result shown in this graph is well in agreement with the line gap conditions of having explained by the term of the above-mentioned "explanation of the gestalt of operation."
[0075] If the line gap n is set as 1 so that clearly from drawing 21 , it is impossible that is, to distinguish from a solid image, although it is necessary to set the line gap n or more to two in order to avoid the effect of adjoining 1-dot lines.
[0076] It is desirable to set up the line gap n so that the above-mentioned inequality (1) may be satisfied on the other hand, in order to obtain sufficient detection sensitivity, and it is n<= (8x23.6-10) / 10= 17.88 (book) at this example.
It is satisfied, that is, it is desirable to set the line gap n or less to 17. A blank paper image and distinction stop the line gap n sticking or more by 18, and detection of exact image concentration is difficult so that clearly from this point and drawing 21 .
[0077] Moreover, it is desirable to satisfy the above-mentioned inequality (2), in order to suppress a detection gap and to perform highly precise detection, and it is n<= (8x23.6-20) / 20= 8.44 (book) at this example.
It is satisfied, that is, it is desirable to set the line gap n or less to eight, and it is most desirable to set the line gap n as 5 in this example.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing showing the operation gestalt of 1 of the image formation equipment concerning this invention.
[Drawing 2] It is the block diagram showing the electric configuration of the image formation equipment of drawing 1 .
[Drawing 3] It is the flow chart which shows the concentration adjustment actuation in the image formation equipment of drawing 1 .
[Drawing 4] It is the flow chart which shows the content of development bias calculation processing of drawing 3 .
[Drawing 5] It is the flow chart which shows the content of bias calculation processing in the extensive range of drawing 4 .
[Drawing 6] It is the mimetic diagram showing the content of processing of drawing 5 , and the content of bias calculation processing in the ** range explained later.
[Drawing 7] It is drawing showing the 1st patch image.
[Drawing 8] It is drawing showing the formation sequence of a patch image.
[Drawing 9] It is the flow chart which shows the content of bias calculation processing (1) in the ** range of drawing 4 .
[Drawing 10] It is the flow chart which shows the content of bias calculation processing (2) in the ** range of drawing 4 .
[Drawing 11] It is the mimetic diagram showing the content of processing of drawing 10 .
[Drawing 12] It is the flow chart which shows the content of electrification bias calculation processing of drawing 3 .

[Drawing 13] It is the mimetic diagram showing the content of processing of drawing 10 .
[Drawing 14] It is drawing showing the 2nd patch image.
[Drawing 15] It is drawing showing the relation between the 1st patch image, and surface potential and development bias potential.
[Drawing 16] It is drawing showing the relation between the 2nd patch image, and surface potential and development bias potential.
[Drawing 17] It is the graph which shows the optical intensity distribution of the laser beam irradiated by the photo conductor front face.
[Drawing 18] It is the mimetic diagram showing the relative relation of the detection field of a patch sensor and 1-dot line accompanying change of a line gap.
[Drawing 19] It is drawing for explaining the detection gap accompanying change of the relative location of the detection field of a patch sensor, and a 1-dot line.
[Drawing 20] It is the mimetic diagram showing other operation gestalten of a patch image.
[Drawing 21] It is the graph which shows the situation of output change of a patch sensor to change of a line gap.
[Description of Notations]
1 — Control unit (control means)
2 — Image support unit
3 — Exposure unit
11 — Maine controller (control means)
12 — Engine controller (control means)
21 — Photo conductor
22 — Electrification roller (electrification means)
23 — Development section
23Y, 23C, 23M, 23K — Development counter
41 — Medium imprint belt (transfer medium)
121 — Electrification bias generating section
123 — CPU (control section)
125 — Development bias generating section
127 — RAM (storage means)
IR — (patch sensor) Detection field
L — Laser beam

PI2 — Patch image
PI2' — Rectangular grid image (patch image)
PS — Patch sensor (concentration detection means)

[Translation done.]

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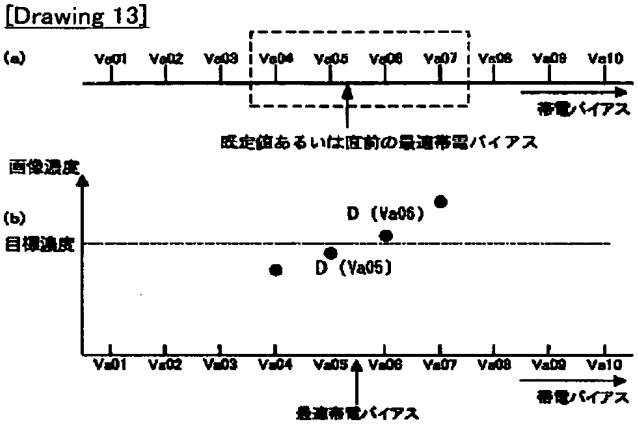
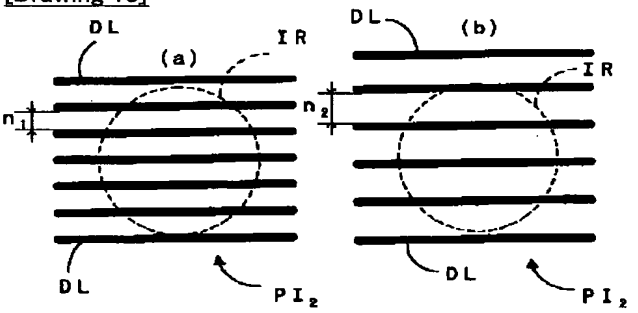
DRAWINGS

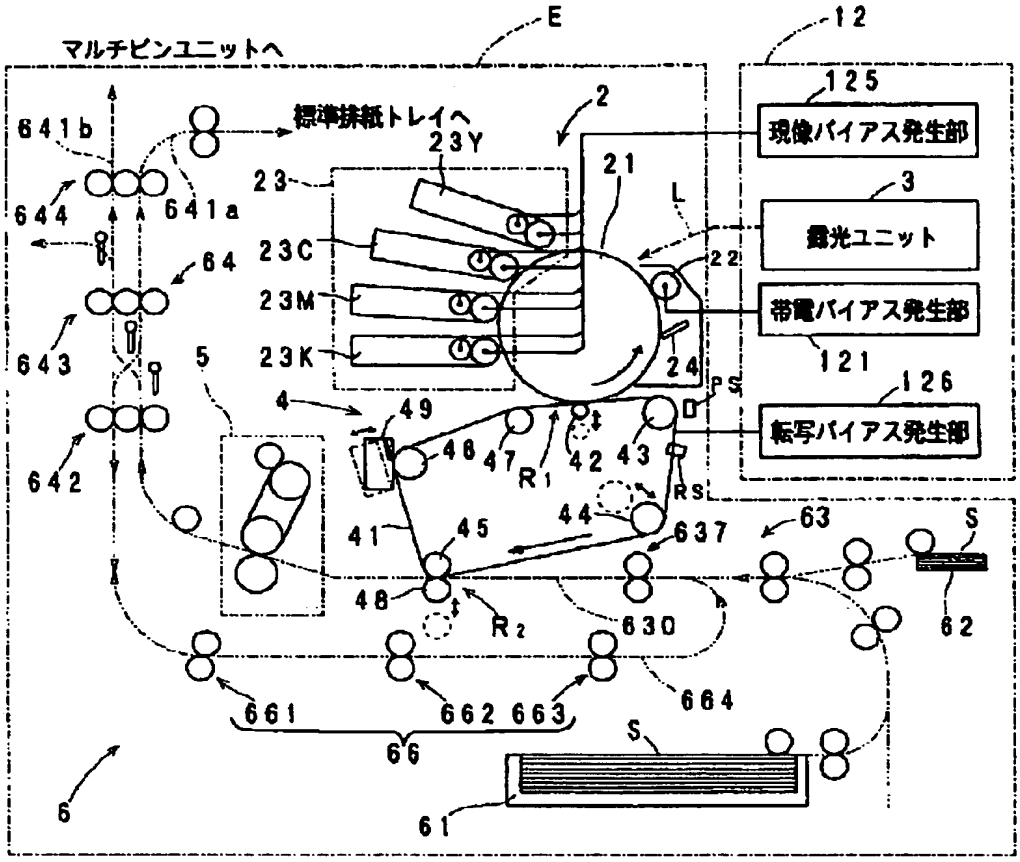
[Drawing 13]



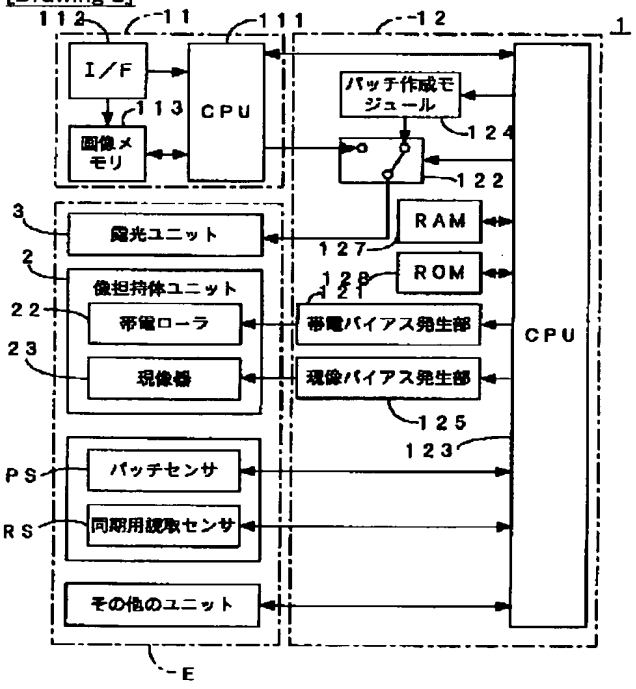
[Drawing 18]



[Drawing 1]



[Drawing 2]



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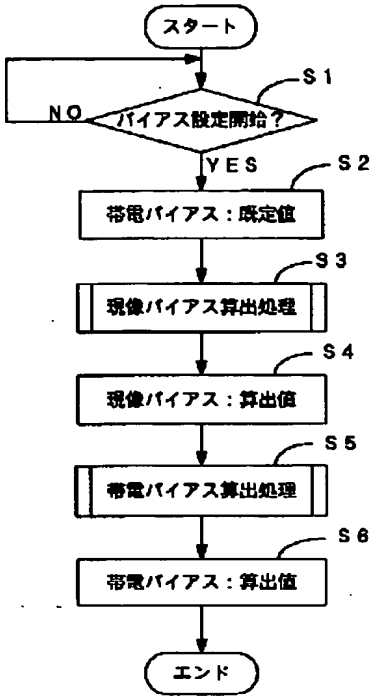

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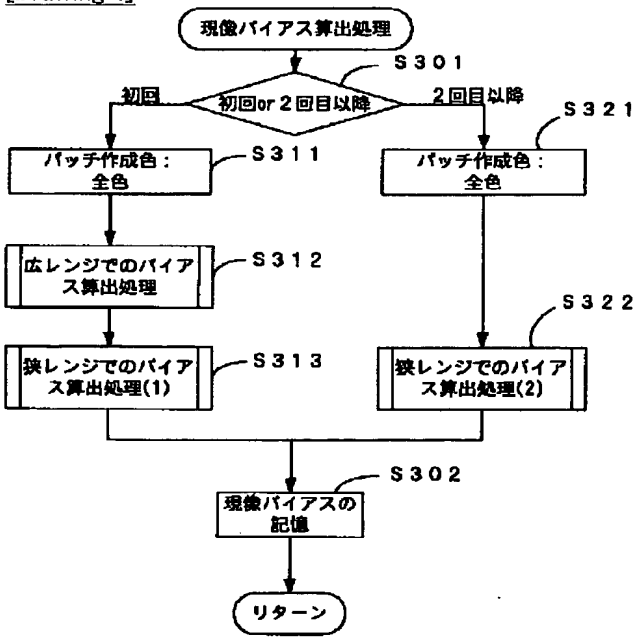

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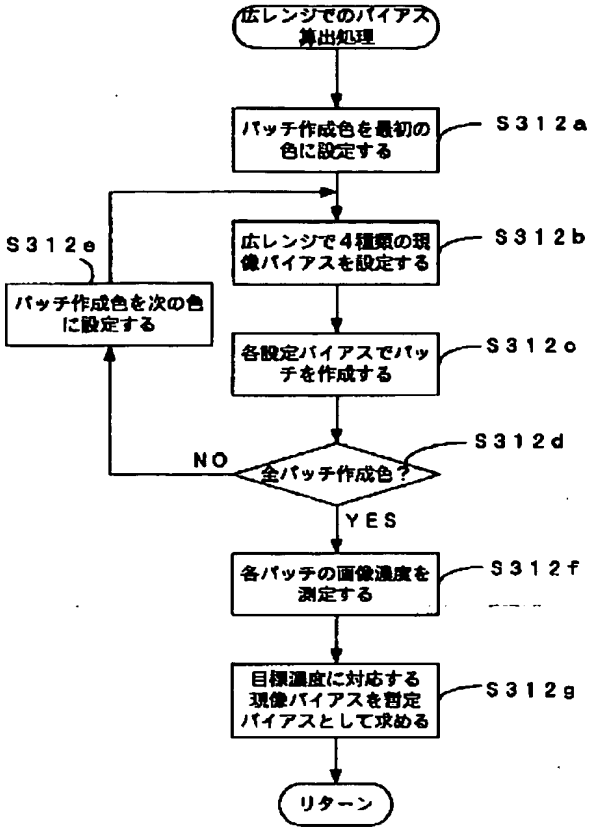

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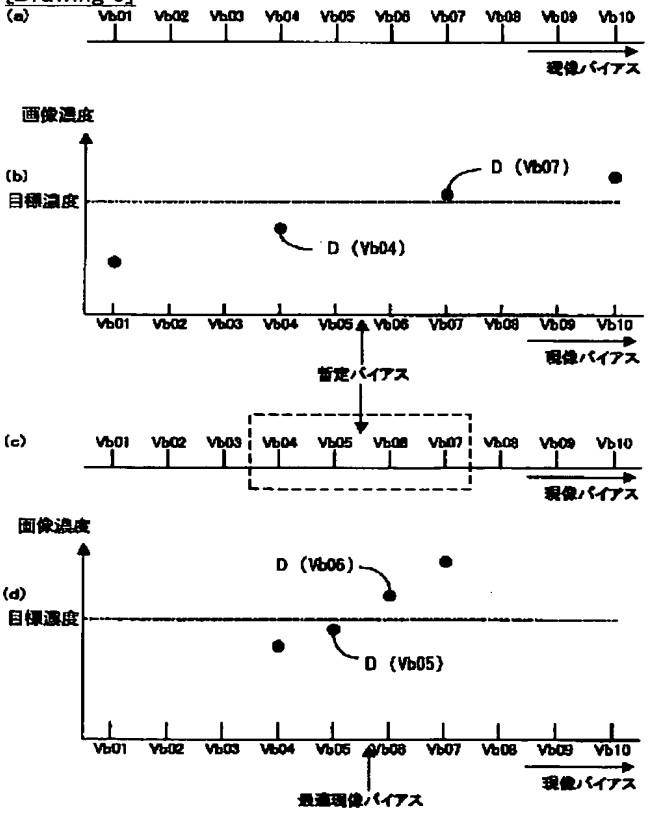

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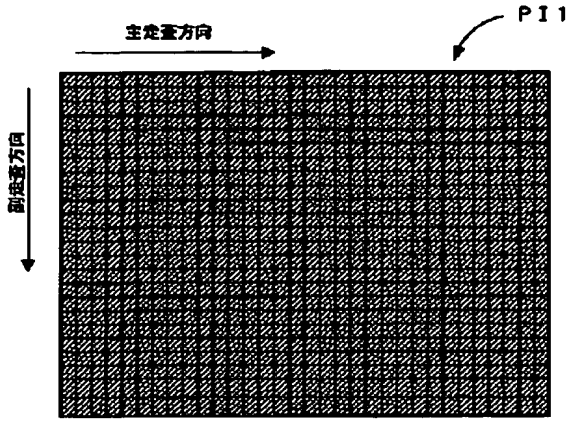

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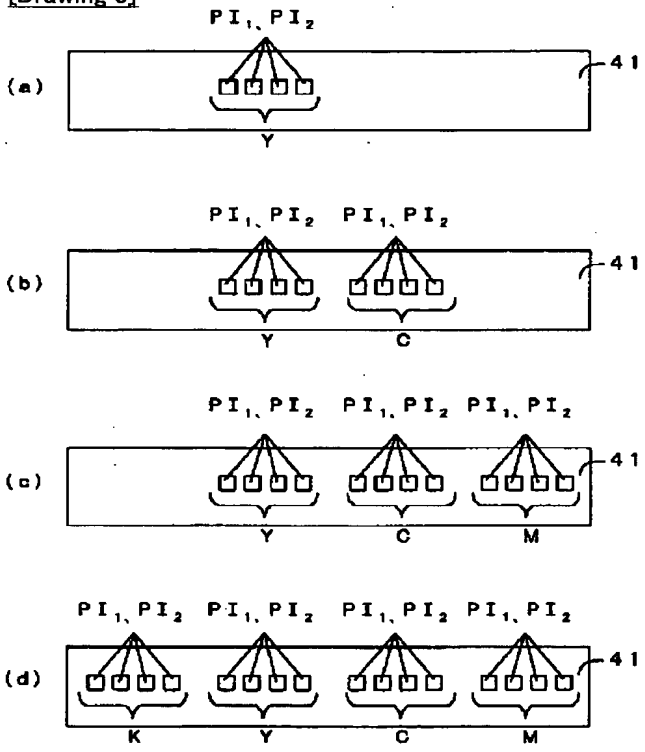
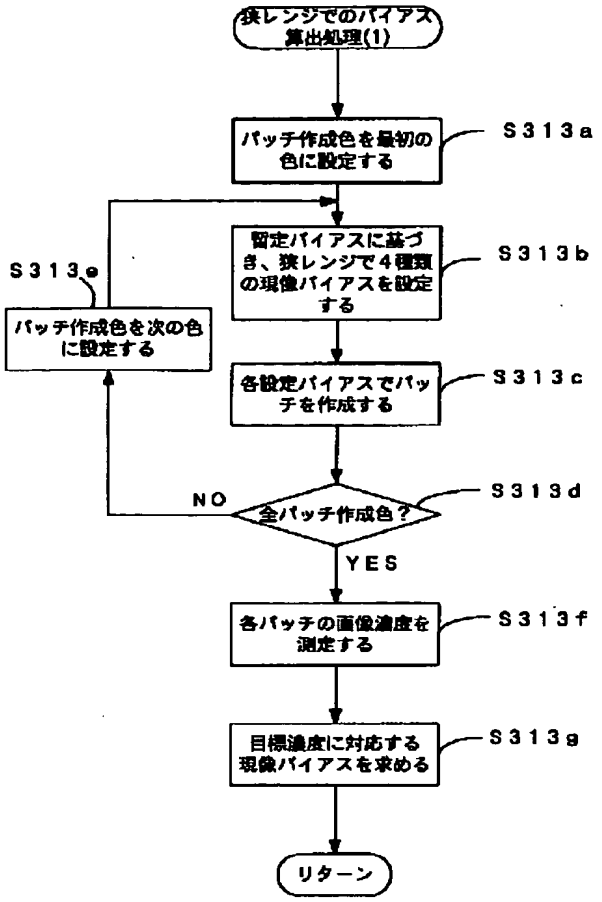
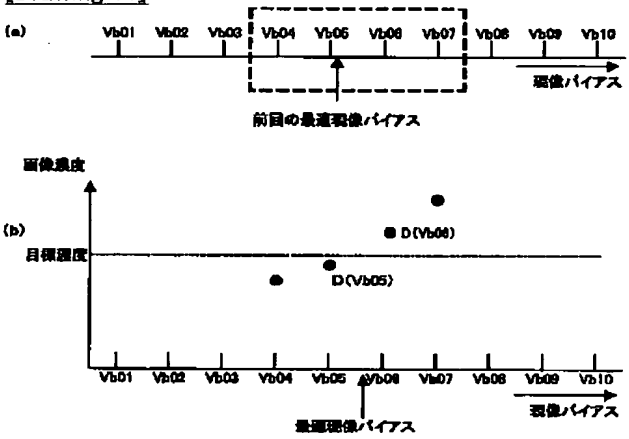


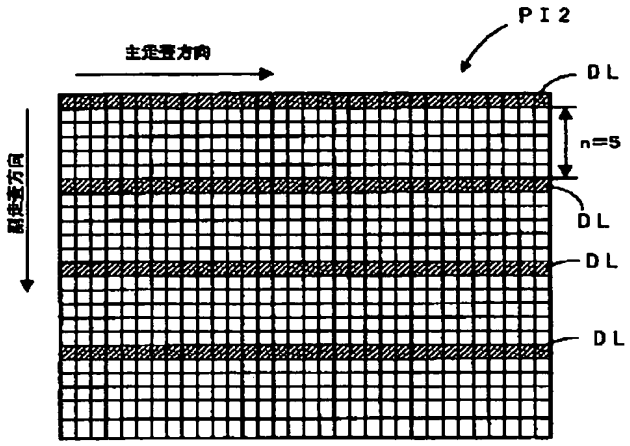
[Drawing 9]



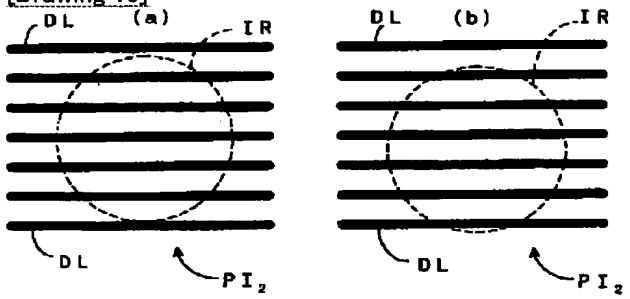
[Drawing 11]



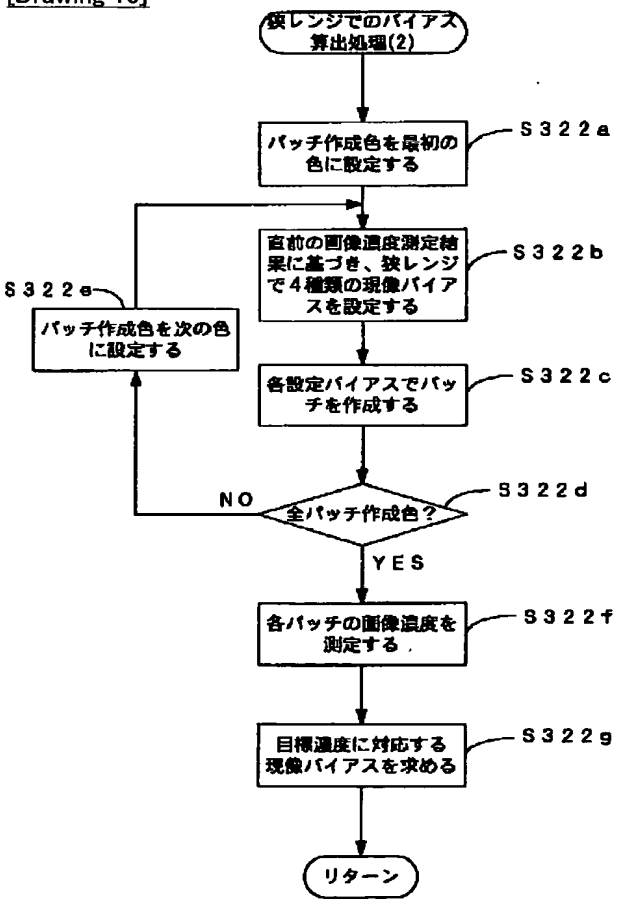
[Drawing 14]



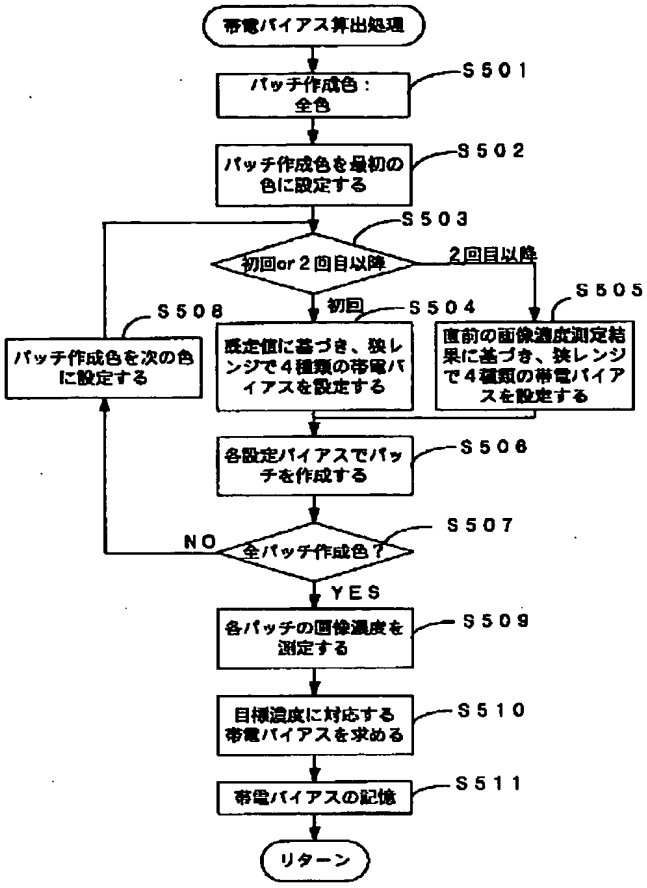
[Drawing 19]



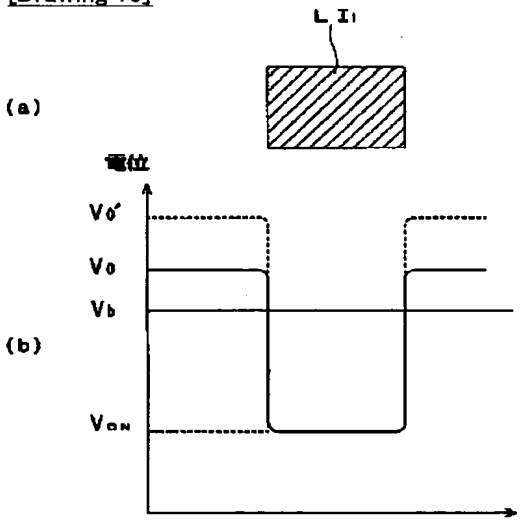
[Drawing 10]



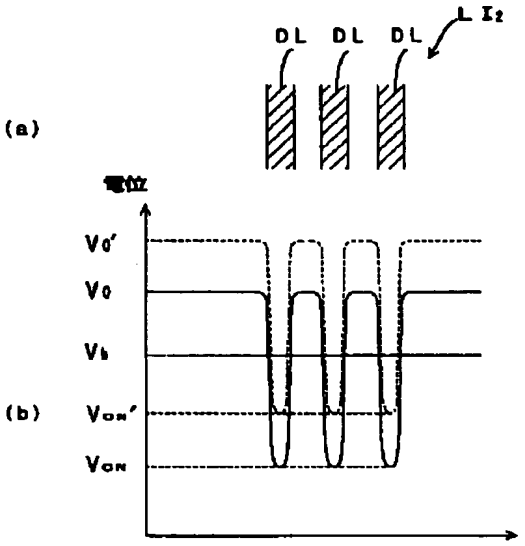
[Drawing 12]



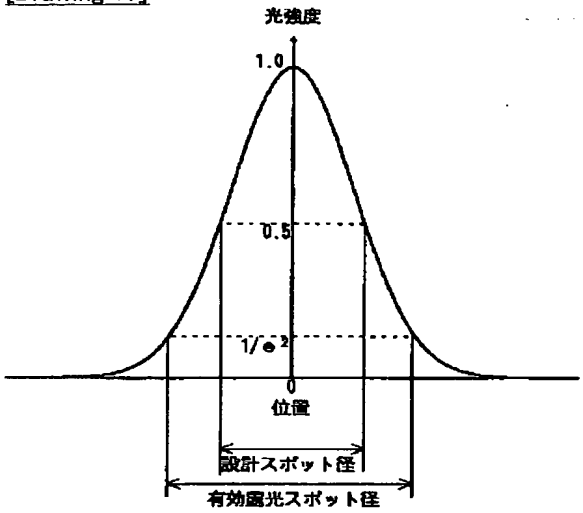
[Drawing 15]



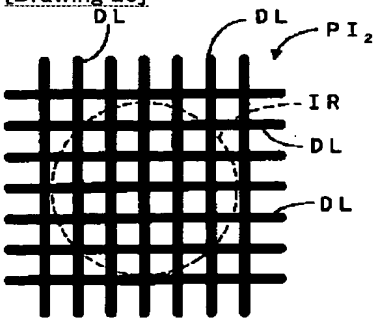
[Drawing 16]



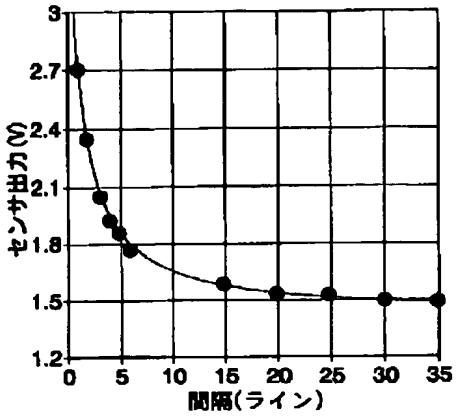
[Drawing 17]



[Drawing 20]



[Drawing 21]



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Ｂ４１Ｊ　2/44		15/02	１０２	２Ｈ００３
Ｇ０３Ｇ　15/02	１０２	Ｂ４１Ｊ　3/00	Ｄ	２Ｈ０２７

審査請求　有　請求項の数21　ＯＬ　（全 19 頁）

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(22)出願日　平成11年７月28日(1999.7.28)

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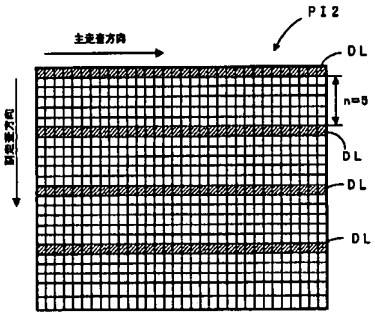
弁理士　振角　正一　（外３名）

Ｆターム(参考)　2C362 CB73 CB80
2H003 AA02 BB11 DD03
2H027 DA09 DE02 EA01 EA05 EC03

(54)【発明の名称】　画像形成装置および画像形成方法

(57)【要約】
【課題】　線画像の画像濃度を安定化させることができる画像形成装置および画像形成方法を提供する。
【解決手段】　パッチ画像ＰＩ2は、互いに離隔配置された複数本の１ドットラインＤＬで構成されており、このパッチ画像ＰＩ2の画像濃度を検出し、その検出結果に基づきトナー像の画像濃度を目標濃度に調整している。このため、１ドットラインＤＬからなる線画像の画像濃度の安定化を図ることができ、精密な画像も適切な画像濃度で安定して形成することができる。



1

【特許請求の範囲】
【請求項１】　感光体の表面を帯電させる帯電手段と、前記感光体の表面に静電潜像を形成する露光手段と、前記静電潜像をトナーにより顕在化してトナー像を形成する現像手段と、
前記現像手段によって前記感光体上に形成されたトナー像、あるいは当該トナー像が転写媒体に転写されてなるトナー像をパッチ画像として、その画像濃度を検出する濃度検出手段と、
前記濃度検出手段の検出結果に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備え、
前記パッチ画像は、互いに離隔配置された複数本の１ドットラインで構成されていることを特徴とする画像形成装置。
【請求項２】　前記制御手段は、帯電バイアスを段階的に変化させながら、前記複数のパッチ画像を順次形成し、前記濃度検出手段によって検出された各パッチ画像の濃度に基づいて目標濃度を得るために必要な最適帯電バイアスを決定する請求項１記載の画像形成装置。
【請求項３】　前記制御手段は、帯電バイアスを段階的に増大させながら、前記複数のパッチ画像を形成する請求項２記載の画像形成装置。
【請求項４】　前記帯電手段は、帯電バイアスを与えられた導電体を前記感光体の表面と接触させて当該表面を接触帯電させる請求項１ないし３のいずれかに記載の画像形成装置。
【請求項５】　前記複数本の１ドットラインは、相互にほぼ平行であり、しかも、隣接する１ドットライン同士はｎライン間隔（ｎ≧２の整数）だけ離隔している請求項１ないし４のいずれかに記載の画像形成装置。
【請求項６】　前記濃度検出手段は大きさφの検出領域を有し、また前記画像形成装置は解像度Ｒを有するとき、隣接する１ドットライン同士のライン間隔ｎは、
ｎ≦（φ・Ｒ－１０）／１０
をさらに満足する整数である請求項５記載の画像形成装置。
【請求項７】　前記濃度検出手段は大きさφの検出領域を有し、また前記画像形成装置は解像度Ｒを有するとき、隣接する１ドットライン同士のライン間隔ｎは、
ｎ≦（φ・Ｒ－２０）／２０
をさらに満足する整数である請求項５記載の画像形成装置。
【請求項８】　前記パッチ画像は、前記複数本の１ドットラインを格子状に配置してなる格子画像である請求項１ないし４のいずれかに記載の画像形成装置。
【請求項９】　前記パッチ画像は、前記複数本の１ドットラインを相互に直交配置してなる直交格子画像である請求項８記載の画像形成装置。
【請求項１０】　帯電手段によって感光体の表面を帯電させた後、この感光体の表面に静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成方法において、
トナー像の画像濃度に影響を与える濃度制御因子を変化させながら、互いに離隔配置された複数本の１ドットラインで構成されるトナー像をパッチ画像として順次形成した後、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適な濃度制御因子を決定することを特徴とする画像形成方法。
【請求項１１】　前記濃度制御因子として、前記帯電手段に与える帯電バイアスを変化させながら、複数のトナー像をパッチ画像として順次形成した後、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適帯電バイアスを決定する請求項１０記載の画像形成方法。
【請求項１２】　帯電バイアスを段階的に増大させながら、前記複数のパッチ画像を形成する請求項１１記載の画像形成方法。
【請求項１３】　前記複数本の１ドットラインは、相互にほぼ平行であり、しかも、隣接する１ドットライン同士はｎライン間隔（ｎ≧２の整数）だけ離隔している請求項１０ないし１２のいずれかに記載の画像形成方法。
【請求項１４】　パッチ画像の検出領域の大きさをφとし、解像度をＲとしたとき、隣接する１ドットライン同士のライン間隔ｎが、
ｎ≦（φ・Ｒ－１０）／１０
をさらに満足する整数となるように、前記パッチ画像を形成する請求項１３記載の画像形成方法。
【請求項１５】　パッチ画像の検出領域の大きさをφとし、解像度をＲとしたとき、隣接する１ドットライン同士のライン間隔ｎが、
ｎ≦（φ・Ｒ－２０）／２０
をさらに満足する整数となるように、前記パッチ画像を形成する請求項１３記載の画像形成方法。
【請求項１６】　前記パッチ画像を、前記複数本の１ドットラインを格子状に配置してなる格子画像としている請求項１０ないし１２のいずれかに記載の画像形成方法。
【請求項１７】　前記パッチ画像を、前記複数本の１ドットラインを相互に直交配置してなる直交格子画像としている請求項１６記載の画像形成方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、帯電手段によって感光体の表面を帯電させた後、この感光体の表面に静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成装置および画像形成方法に関するものである。
【０００２】
【従来の技術】この種の画像形成装置では、感光体およびトナーの疲労・経時変化や、装置周辺における温湿度

の変化などに起因して、画像濃度が変化することがある。そこで、従来よりトナー像の画像濃度に影響を与える濃度制御因子、例えば帯電バイアス、現像バイアス、露光量などを適宜調整して画像濃度を安定化させる技術が数多く提案されている。例えば、特開平９－５０１５５号公報に記載の発明では、３ドットラインのペア群を３ドットおきに出力してなるパッチ画像を感光体ドラム上に形成し、このパッチ画像をセンサによって読み取ることでライン幅を検出している。そして、こうして検出されるライン幅に基づき、レーザーパワーを制御することで所望のライン幅が得られるように露光量を調整し、理想のライン線画像を得ている。

【０００３】

【発明が解決しようとする課題】しかしながら、線画像の基本はレーザービーム１本で描画される１ドットラインであり、従来例の如く複数ドットラインのライン幅を制御しただけでは線画像を十分に調整したとはいえない。

【０００４】この発明は上記課題に鑑みなされたものであり、線画像の画像濃度を安定化させることができる画像形成装置および画像形成方法を提供することを目的とする。

【０００５】

【課題を解決するための手段】この発明にかかる画像形成装置は、感光体の表面を帯電させる帯電手段と、前記感光体の表面に静電潜像を形成する露光手段と、前記静電潜像をトナーにより顕在化してトナー像を形成する現像手段と、前記現像手段によって前記感光体上に形成されたトナー像、あるいは当該トナー像が転写媒体に転写されてなるトナー像をパッチ画像として、その画像濃度を検出する濃度検出手段と、前記濃度検出手段の検出結果に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備え、上記目的を達成するため、前記パッチ画像を、互いに離隔配置された複数本の１ドットラインで構成している。

【０００６】また、この発明にかかる画像形成方法は、帯電手段によって感光体の表面を帯電させた後、この感光体の表面に静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成方法であって、上記目的を達成するため、トナー像の画像濃度に影響を与える濃度制御因子を変化させながら、互いに離隔配置された複数本の１ドットラインで構成されるトナー像をパッチ画像として順次形成した後、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適な濃度制御因子を決定している。

【０００７】これらの発明では、互いに離隔配置された複数本の１ドットラインで構成されるトナー像がパッチ画像として形成される。そして、このパッチ画像の画像濃度が検出されるとともに、その検出結果に基づきトナー像の画像濃度が目標濃度に調整されて１ドットラインからなる線画像の画像濃度の安定化が図られる。

【０００８】なお、画像濃度の調整については、例えば次のように行ってもよい。すなわち、トナー像の画像濃度に影響を与える濃度制御因子として帯電手段に与える帯電バイアスを変化させながら、複数のトナー像をパッチ画像として順次形成した後、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適帯電バイアスを決定すればよい。

【０００９】また、帯電バイアスを変化させる際、段階的に増大させるのが望ましい。というのも、帯電バイアスをステップ的に変化させる場合、減少方向よりも増大方向に変化させる方が電源の応答性の点で優れているからである。このように帯電バイアスを段階的に変化させる具体的な手段として、接触帯電を用いることができる。

【００１０】また、パッチ画像を構成する複数本の１ドットラインについては、相互にほぼ平行であり、しかも、隣接する１ドットライン同士がｎライン間隔（ｎ≧２の整数）だけ離隔しているのが望ましい。また、濃度検出手段の検出領域の大きさをφとし、画像形成装置の解像度をＲとすれば、隣接する１ドットライン同士のライン間隔ｎを、

ｎ≦（φ・Ｒ－１０）／１０

に設定するのが望ましく、さらには、

ｎ≦（φ・Ｒ－２０）／２０

に設定するのがより好適である。このように、ライン間隔ｎの上限値および下限値を設定するのが望ましい理由については、後の「発明の実施の形態」および「実施例」の項で詳述する。

【００１１】さらに、パッチ画像を、複数本の１ドットラインを格子状に配置してなる格子画像で構成してもよく、この場合、複数本の１ドットラインを平行配置したパッチ画像に比べて濃度検出手段の検出領域に入るライン数が増えてより検出感度が増大する。

【００１２】

【発明の実施の形態】Ａ．画像形成装置の全体構成

図１は、この発明にかかる画像形成装置の一の実施形態を示す図である。また、図２は図１の画像形成装置の電気的構成を示すブロック図である。この画像形成装置は、イエロー（Ｙ）、シアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の４色のトナーを重ね合わせてフルカラー画像を形成したり、ブラック（Ｋ）のトナーのみを用いてモノクロ画像を形成する装置である。この画像形成装置では、ホストコンピュータなどの外部装置から画像信号が制御ユニット１のメインコントローラ１１に与えられると、このメインコントローラ１１からの指令に応じてエンジンコントローラ１２がエンジン部Ｅの各部を制御してシートＳに画像信号に対応する画像を形成する。

【００１３】このエンジン部Ｅでは、像担持体ユニット２の感光体２１にトナー像を形成可能となっている。すなわち、像担持体ユニット２は、図１の矢印方向に回転可能な感光体２１を備えており、さらに感光体２１の周りにその回転方向に沿って、帯電手段としての帯電ローラ２２、現像手段としての現像器２３Ｙ，２３Ｃ，２３Ｍ，２３Ｋ、およびクリーニング部２４がそれぞれ配置されている。帯電ローラ２２は帯電バイアス発生部１２１から高電圧が印加されており、感光体２１の外周面に当接して外周面を均一に帯電させる。

【００１４】そして、この帯電ローラ２２によって帯電された感光体２１の外周面に向けて露光ユニット３からレーザ光Ｌが照射される。この露光ユニット３は、図２に示すように、画像信号切換部１２２と電気的に接続されており、この画像信号切換部１２２を介して与えられる画像信号に応じてレーザ光Ｌを感光体２１上に走査露光して感光体２１上に画像信号に対応する静電潜像を形成する。例えば、エンジンコントローラ１２のＣＰＵ１２３からの指令に基づき、画像信号切換部１２２がパッチ作成モジュール１２４と導通している際には、パッチ作成モジュール１２４から出力されるパッチ画像信号が露光ユニット３に与えられてパッチ潜像が形成される。一方、画像信号切換部１２２がメインコントローラ１１のＣＰＵ１１１と導通している際には、ホストコンピュータなどの外部装置よりインターフェース１１２を介して与えられた画像信号に応じてレーザ光Ｌを感光体２１上に走査露光して感光体２１上に画像信号に対応する静電潜像が形成される。

【００１５】こうして形成された静電潜像は現像部２３によってトナー現像される。すなわち、この実施形態では現像部２３として、イエロー用の現像器２３Ｙ、シアン用の現像器２３Ｃ、マゼンタ用の現像器２３Ｍ、およびブラック用の現像器２３Ｋがこの順序で感光体２１に沿って配置されている。これらの現像器２３Ｙ，２３Ｃ，２３Ｍ，２３Ｋは、それぞれ感光体２１に対して接離自在に構成されており、エンジンコントローラ１２からの指令に応じて、上記４つの現像器２３Ｙ、２３Ｍ、２３Ｃ、２３Ｂのうちの一の現像器が選択的に感光体２１に当接するとともに、現像バイアス発生部１２５によって高電圧が印加されて選択された色のトナーを感光体２１の表面に付与して感光体２１上の静電潜像を顕在化する。

【００１６】現像部２３で現像されたトナー像は、ブラック用現像器２３Ｋとクリーニング部２４との間に位置する一次転写領域Ｒ１で転写ユニット４の中間転写ベルト４１上に一次転写される。なお、この転写ユニット４の構造については後で詳述する。

【００１７】また、一次転写領域Ｒ１から周方向（図１の矢印方向）に進んだ位置には、クリーニング部２４が配置されており、一次転写後に感光体２１の外周面に残

留付着しているトナーを掻き落とす。

【００１８】次に、転写ユニット４の構成について説明する。この実施形態では、転写ユニット４は、ローラ４２～４７と、これら各ローラ４２～４７に掛け渡された中間転写ベルト４１と、この中間転写ベルト４１に転写された中間トナー像をシートＳに二次転写する二次転写ローラ４８とを備えている。この中間転写ベルト４１には、転写バイアス発生部１２６から一次転写電圧が印加されている。そして、カラー画像をシートＳに転写する場合には、感光体２１上に形成される各色のトナー像を中間転写ベルト４１上に重ね合わせてカラー像を形成するとともに、給排紙ユニット６の給紙部６３によってカセット６１、手差しトレイ６２あるいは増設カセット（図示省略）からシートＳを取出して二次転写領域Ｒ２に搬送する。そして、このシートＳに、カラー像を二次転写してフルーカラー画像を得る。また、モノクロ画像をシートＳに転写する場合には、感光体２１上にブラックトナー像のみを中間転写ベルト４１上に形成し、カラー画像の場合と同様にして二次転写領域Ｒ２に搬送されてきたシートＳに転写してモノクロ画像を得る。

【００１９】なお、二次転写後、中間転写ベルト４１の外周面に残留付着しているトナーについては、ベルトクリーナ４９によって除去される。このベルトクリーナ４９は、中間転写ベルト４１を挟んでローラ４６と対向して配置されており、適当なタイミングでクリーナブレードが中間転写ベルト４１に対して当接してその外周面に残留付着しているトナーを掻き落す。

【００２０】また、ローラ４３の近傍には、後述するようにして中間転写ベルト４１の外周面に形成されるパッチ画像の濃度を検出するためのパッチセンサＰＳが配置されるとともに、中間転写ベルト４１の基準位置を検出するための同期用読取センサＲＳが配置されている。

【００２１】図１に戻ってエンジン部Ｅの構成説明を続ける。転写ユニット４によってトナー像が転写されたシートＳは、給排紙ユニット６の給紙部６３によって所定の給紙経路（２点鎖線）に沿って二次転写領域Ｒ２の下流側に配設された定着ユニット５に搬送され、搬送されてくるシートＳ上のトナー像をシートＳに定着する。そして、当該シートＳはさらに給紙経路６３０に沿って排紙部６４に搬送される。

【００２２】この排紙部６４は２つの排紙経路６４１ａ，６４１ｂを有しており、一方の排紙経路６４１ａは定着ユニット５から標準排紙トレイに延びるとともに、他方の排紙経路６４１ｂは排紙経路６４１ａとほぼ平行に、再給紙部６６とマルチビンユニットとの間に延びている。これらの排紙経路６４１ａ，６４１ｂに沿って３組のローラ対６４２～６４４が設けられており、定着済みのシートＳを標準排紙トレイやマルチビンユニット側に向けて排出したり、その他方面側にも画像を形成するために再給紙部６６側に搬送したりする。

【００２３】この再給紙部６６は、図１に示すように、上記のように排紙部６４から反転搬送されてきたシートＳを再給紙経路６６４（２点鎖線）に沿って給紙部６３のゲートローラ対６３７に搬送するものであり、再給紙経路６６４に沿って配設された３つの再給紙ローラ対６６１～６６３で構成されている。このように、排紙部６４から搬送されてきたシートＳを再給紙経路６６４に沿ってゲートローラ対６３７に戻すことによって給紙部６３においてシートＳの非画像形成面が中間転写ベルト４１を向いて当該面に画像を二次転写可能となる。

【００２４】なお、図２において、符号１１３はホストコンピュータなどの外部装置よりインターフェース１１２を介して与えられた画像を記憶するためにメインコントローラ１１に設けられた画像メモリであり、符号１２７はエンジン部Ｅを制御するための制御データやＣＰＵ１２３における演算結果などを一時的に記憶するためのＲＡＭであり、さらに符号１２８はＣＰＵ１２３で行う演算プログラムなどを記憶するＲＯＭである。

【００２５】Ｂ．画像形成装置における濃度調整動作

次に、上記のように構成され画像形成装置における画像の濃度調整動作について説明する。

【００２６】図３は、図１の画像形成装置における濃度調整動作を示すフローチャートである。この画像形成装置では、同図に示すように、ステップＳ１で濃度調整動作を実行して現像バイアスおよび帯電バイアスを更新設定する必要があるか否かが判断される。例えば、画像形成装置本体のメイン電源を投入した後、画像を形成できる状態になると、バイアス設定を開始するように構成してもよい。また、装置本体内に設けられたタイマー（図示省略）によって連続使用時間を計測し、数時間毎にバイアス設定を開始するようにしてもよい。

【００２７】このステップＳ１で「ＹＥＳ」と判断されてバイアス設定が開始されると、ステップＳ２，Ｓ３を実行して最適現像バイアスを算出し、それを現像バイアスとして設定する（ステップＳ４）。また、それに続いて、ステップＳ５を実行して最適帯電バイアスを算出し、それを帯電バイアスとして設定する（ステップＳ６）。こうして、現像バイアスおよび帯電バイアスの最適化が行われる。以下、現像バイアス算出処理（ステップＳ３）および帯電バイアス算出処理（ステップＳ５）の内容について、それぞれ詳細に説明する。

【００２８】Ｂ－１．現像バイアス算出処理

図４は、図３の現像バイアス算出処理の内容を示すフローチャートである。この現像バイアス算出処理（ステップＳ３）では、まず画像形成装置本体のメイン電源が投入された後、最初に行われるのか、あるいは２回目以降であるのかを判断する（ステップＳ３０１）。そして、初回と判断した場合には、すべての色（この実施形態では、イエロー（Ｙ）、シアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の４色）についてパッチ画像を形成する旨の設定を行った（ステップＳ３１１）後、ステップＳ３１２に進んで比較的広いレンジで、しかも比較的広い間隔で段階的に現像バイアスを変化させながら、複数のパッチ画像を形成し、各パッチ画像の濃度に基づき最適画像濃度を得るために必要な現像バイアスを暫定的に求める。その処理内容について、図５をおよび図６参照しつつ詳述する。

【００２９】図５は、図４の広レンジでのバイアス算出処理の内容を示すフローチャートである。また、図６は、図５の処理内容、および後で説明する狭レンジでのバイアス算出処理の内容を示す模式図である。この算出処理では、パッチ画像を作成する色を最初の色、例えばイエローに設定する（ステップＳ３１２ａ）。そして、帯電バイアスを予めステップＳ２で設定した既定値で、かつ広レンジの範囲内で現像バイアスを比較的広い間隔（第１間隔）で４段階に設定する（ステップＳ３１２ｂ）。例えば、この実施形態では、現像バイアス発生部１２５によって現像部２３に供給可能な現像バイアスの可変帯域（Ｖｂ01～Ｖｂ10）全体を広レンジとして設定し、この広レンジ（Ｖｂ01～Ｖｂ10）内のうち４点Ｖｂ01，Ｖｂ04，Ｖｂ07，Ｖｂ10を現像バイアスとして設定している。このように、この実施形態では、第１間隔Ｗ1を、

Ｗ1＝Ｖｂ10－Ｖｂ07＝Ｖｂ07－Ｖｂ04＝Ｖｂ04－Ｖｂ01

としている。

【００３０】このようなバイアス設定で４つのイエローベタ画像（図７）を感光体上に順次形成し、さらに図８（ａ）に示すように、これらを中間転写ベルト４１の外周面に転写して第１パッチ画像ＰＩＩを形成する（ステップＳ３１２ｃ）。なお、この実施形態では、第１パッチ画像ＰＩＩをベタ画像としているが、その理由については後で詳述する。

【００３１】次のステップＳ３１２ｄは、すべてのパッチ作成色についてパッチ画像を作成したか否かを判断し、「ＮＯ」と判断される間は、パッチ作成色を次の色に設定し（ステップＳ３１２ｅ）、ステップＳ３１２ｂ，Ｓ３１２ｃを繰り返して図８（ｂ）～（ｄ）に示すようにシアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の順序で中間転写ベルト４１の外周面上に第１パッチ画像ＰＩＩをさらに形成していく。

【００３２】一方、ステップＳ３１２ｄで「ＹＥＳ」と判断すると、１６（＝４種類×４色）個のパッチ画像ＰＩＩの画像濃度をパッチセンサＰＳで測定する（ステップＳ３１２ｆ）。この実施形態では、すべてのパッチ作成色についてパッチ画像ＰＩＩを形成した後で、一括してパッチ画像ＰＩＩの画像濃度を測定しているが、各パッチ作成色のパッチ画像ＰＩＩを形成する毎にパッチ画像ＰＩＩの画像濃度を順次測定するようにしてもよい。この点に関しては、後のバイアス算出処理（図９，図１０および図１２）においても同様である。

【００３３】これに続いて、ステップＳ３１２ｇで目標濃度に対応する現像バイアスを求め、これを暫定バイアスとしてＲＡＭ１２７に一時的に記憶する。ここで、測定結果（画像濃度）が目標濃度と一致している場合には、その画像濃度に対応する現像バイアスを暫定バイアスとすればよく、また一致しない場合には、図６（ｂ）に示すように、目標濃度を挟むデータＤ（Ｖｂ04），Ｄ（Ｖｂ07）に基づく直線補間や平均化処理などによって暫定バイアスを求めることができる。

【００３４】こうして、暫定バイアスが求まると、図４の狭レンジでのバイアス算出処理（１）を実行する。図９は、図４の狭レンジでのバイアス算出処理（１）の内容を示すフローチャートである。この算出処理では、先の算出処理（ステップＳ３１２）と同様に、パッチ画像を作成する色を最初の色、例えばイエローに設定する（ステップＳ３１３ａ）。そして、帯電バイアスを予めステップＳ２で設定した既定値で、かつステップＳ３１２で求めた暫定バイアスを含む狭レンジの範囲内で現像バイアスを第１間隔Ｗ1よりも狭い間隔（第２間隔）で４段階に設定する（ステップＳ３１３ｂ）。例えば、この実施形態では、現像バイアスの可変帯域（Ｖｂ01～Ｖｂ10）の約１／３を狭レンジとして設定しており、暫定バイアスが図６（ｂ）に示すように現像バイアスＶｂ05，Ｖｂ06の間である場合には、４点Ｖｂ04，Ｖｂ05，Ｖｂ06，Ｖｂ07を現像バイアスとして設定している（同図（ｃ））。このように、この実施形態では、第２間隔Ｗ2を、

Ｗ2＝Ｖｂ07－Ｖｂ06＝Ｖｂ06－Ｖｂ05＝Ｖｂ05－Ｖｂ04

としている。

【００３５】このようなバイアス設定で４つのイエローベタ画像（図７）を感光体上に順次形成し、さらに図８（ａ）に示すように、これらを中間転写ベルト４１の外周面に転写して第１パッチ画像ＰＩＩを形成する（ステップＳ３１３ｃ）。そして、先の算出処理（ステップＳ３１２）と同様に、ステップＳ３１３ｄですべてのパッチ作成色についてパッチ画像が作成されたと判断するまで、パッチ作成色を次の色に設定し（ステップＳ３１３ｅ）、ステップＳ３１３ｂ，Ｓ３１３ｃを繰り返してシアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の順序で中間転写ベルト４１の外周面上に第１パッチ画像ＰＩＩをさらに形成していく。

【００３６】こうして１６（＝４種類×４色）個のパッチ画像ＰＩＩが中間転写ベルト４１に形成されると、各パッチ画像の画像濃度をパッチセンサＰＳで測定する（ステップＳ３１３ｆ）。これに続いて、ステップＳ３１３ｇで目標濃度に対応する現像バイアスを求める。ここで、測定結果（画像濃度）が目標濃度と一致している場合には、その画像濃度に対応する現像バイアスを暫定バイアスとすればよく、また一致しない場合には、図６（ｄ）に示すように、目標濃度を挟むデータＤ（Ｖｂ05），Ｄ（Ｖｂ06）に基づく直線補間などによって最適現像バイアスを求めることができる。

【００３７】こうして求められた最適現像バイアスについては、ＲＡＭ１２７に記憶して（図４のステップＳ３０２）、後述する帯電バイアスの算出時や通常の画像形成処理において、ＲＡＭ１２７から読み出し、現像バイアスとして設定する。

【００３８】以上のように、この実施形態では、広レンジで、かつ第１間隔Ｗ1で目標濃度の画像を得るために必要な現像バイアスを暫定的に求め、さらに暫定バイアスを含む狭レンジで、しかもより細かい間隔（第２間隔）Ｗ2で現像バイアスを設定して目標濃度を得るために必要な現像バイアスを求め、これを最終的に最適現像バイアスとしている。したがって、次のような効果が得られる。

【００３９】例えば画像形成装置本体のメイン電源が投入された時点では、感光体やトナーの特性、また装置周辺の温湿度などはどのように変動しているのか全く予想することができず、現像バイアス可変帯域（Ｖｂ01～Ｖｂ10）全体をカバーするように現像バイアスを設定した上でパッチ画像を形成し、最適現像バイアスを決定する必要がある。そこで、現像バイアス可変帯域（Ｖｂ01～Ｖｂ10）を複数の狭レンジに分け、各狭レンジで上記バイアス算出処理（１）と同様の処理を実行して最適現像バイアスを求めることも可能である。しかしながら、この比較例では、分割数に比例してステップ数が多くなり、最適現像バイアスの算出に時間を要してしまうという問題がある。逆に、分割数を少なくすると、上記問題を解消することができるものの、１つの分割レンジ内でのバイアス間隔が第２バイアス間隔Ｗ2よりも広がり、その結果、最適現像バイアスの算出精度が落ちて画像濃度を目標濃度に正確に調整することができないという別の問題が生じてしまう。

【００４０】これに対して、本実施形態では、上記のように広レンジでのバイアス算出処理（ステップＳ３１２）によって凡その現像バイアスを暫定的に求めた上で、さらに暫定バイアス近傍の狭レンジで、しかも細かい間隔（第２間隔）Ｗ2で現像バイアスを変化させて最適現像バイアスを算出しているので、上記比較例と比べて、短時間で、しかも高精度に最適現像バイアスを求めることができる。

【００４１】ところで、最適帯電バイアスおよび最適現像バイアスは感光体およびトナーの疲労・経時変化などに応じて変化するが、その変化はある程度の連続性を有している。したがって、画像濃度の調整処理を繰り返して実行している際には、直前の画像濃度測定結果（ステップＳ３１３ｆや後述するステップＳ３２２ｆ，Ｓ５１０など）に基づき最適現像バイアスを予想することができる。そこで、この実施形態にかかる現像バイアス算出処理（ステップＳ３）では、画像形成装置本体のメイン

電源が投入された後、２回目以降であると判断する、つまり図４のステップＳ３０１で「２回目以降」と判断した時には、すべての色（この実施形態では、イエロー（Ｙ）、シアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の４色）についてパッチ画像を形成する旨の設定を行った（ステップＳ３２１）後、ステップＳ３２２に進んで狭レンジでのバイアス算出処理（２）を実行して暫定バイアスを求めることなしに最適現像バイアスを求めている。以下、その処理内容について図１０を参照しつつ説明する。

【００４２】図１０は、図４の狭レンジでのバイアス算出処理（２）の内容を示すフローチャートである。また、図１１は、図１０の処理内容を示す模式図である。この算出処理が、先に説明した狭レンジでのバイアス算出処理（１）と大きく相違する点は、図９の算出処理（１）では帯電バイアスを既定値に設定するとともに、暫定バイアスに基づき狭レンジでの４種類の現像バイアスを設定している（ステップＳ３１３ｂ）のに対して、このバイアス算出処理（２）では直前の画像濃度測定によって求められてＲＡＭ１２７に記憶されている最適帯電バイアスを帯電バイアスとして設定するとともに、同ＲＡＭ１２７に記憶されている最適現像バイアスに基づき狭レンジでの４種類の現像バイアスを設定している（ステップＳ３２２ｂ）点であり、その他の構成は同一である。したがって、ここでは、同一構成の説明については、省略する。

【００４３】このように、２回目以降の濃度調整動作については、暫定バイアスを求めずに、直前の画像濃度測定結果（前回の最適現像バイアス）を用いて狭レンジで、しかも第２間隔で４種類の現像バイアスを設定し、各色のパッチ画像を形成して最適現像バイアスを求めるようにしているので、最適現像バイアスをさらに一層短時間で求めることができる。なお、こうして求められた最適現像バイアスについては、ＲＡＭ１２７に既に記憶されている最適現像バイアスと書き換えて最新のものに更新する（図４のステップＳ３０２）。

【００４４】こうして最適現像バイアスが求まると、図３に戻り、上記のようにして算出された最適現像バイアスをＲＡＭ１２７から読み出し、これを現像バイアスとして設定する。そして、最適帯電バイアスを算出し（ステップＳ５）、それを帯電バイアスとして設定する（ステップＳ６）。

【００４５】Ｂ－２．最適帯電バイアス算出処理

図１２は、図３の帯電バイアス算出処理の内容を示すフローチャートである。また、図１３は、図１０の処理内容を示す模式図である。この帯電バイアス算出処理（ステップＳ５）では、すべての色（この実施形態では、イエロー（Ｙ）、シアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の４色）についてパッチ画像を形成する旨の設定を行った（ステップＳ５０１）後、ステップＳ５０２に進んで第２パッチ画像を作成する色を最初の色、例えばイエローに設定する（ステップＳ５０１）。

【００４６】そして、現像バイアス算出処理の場合と同様に、画像形成装置本体のメイン電源が投入された後、帯電バイアス算出処理が最初に行われるのか、あるいは２回目以降であるのかを判断し（ステップＳ５０３）、初回と判断した場合にはステップＳ５０４を実行し、２回目以降であると判断した場合にはステップＳ５０５を実行する。

【００４７】このステップＳ５０４では、予めステップＳ２で設定した既定値を含み、かつ狭レンジの範囲内で帯電バイアスを比較的狭い間隔（第３間隔）で４段階に設定する。一方、ステップＳ５０５では、直前の画像濃度測定結果（最適帯電バイアス）に基づき狭レンジの範囲内で帯電バイアスを比較的狭い間隔（第３間隔）で４段階に設定する。このように、帯電バイアス算出処理は、現像バイアス算出処理とは異なり、広レンジでの算出処理を行うことなく、狭レンジでの算出処理のみを実行する。なお、この実施形態では、帯電バイアスの可変帯域（Ｖａ01～Ｖａ10）の約１／３を狭レンジとして設定しており、例えば既定値あるいは直前の最適帯電バイアスが図１３（ａ）に示すように帯電バイアスＶａ05，Ｖｂ06の間である場合には、４点Ｖａ04，Ｖａ05，Ｖａ06，Ｖａ07を帯電バイアスとして設定している。このように、この実施形態では、第３間隔Ｗ３を、

Ｗ３＝Ｖａ07－Ｖａ06＝Ｖａ06－Ｖａ05＝Ｖａ05－Ｖａ04

としている。

【００４８】上記のようにしてイエロー色について４種類の帯電バイアスが設定されると、帯電バイアスを最も低い値Ｖａ04から段階的に増大させながら、各イエローのハーフトーン画像（図１４）を感光体上に順次形成し、これらを中間転写ベルト４１の外周面に転写して第２パッチ画像ＰＩ２を形成する（図８（ａ）：ステップＳ５０６）。このように、帯電バイアスを段階的に増大させているのは、帯電バイアスをステップ的に変化させる場合、減少方向よりも増大方向に変化させる方が電源の応答性の点で優れているからである。なお、この実施形態では、第２パッチ画像ＰＩ２を、複数本の１ドットラインを相互に５ライン間隔（ｎ＝５）だけ離隔しながら、平行配置してなるハーフトーン画像としているが、その理由については第１パッチ画像をベタ画像としている理由と併せて後で詳述する。

【００４９】次のステップＳ５０７は、すべてのパッチ作成色について第２パッチ画像を作成したか否かを判断し、「ＮＯ」と判断される間は、パッチ作成色を次の色に設定し（ステップＳ５０８）、ステップＳ５０３～Ｓ５０７を繰り返して図８（ｂ）～（ｄ）に示すようにシアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の順序で中間転写ベルト４１の外周面上に第２パッチ画像ＰＩ２をさらに形成していく。

【００５０】一方、ステップＳ５０７で「ＹＥＳ」と判断すると、１６（＝４種類×４色）個のパッチ画像ＰＩ２の画像濃度をパッチセンサＰＳで測定する（ステップＳ５０９）。また、これに続いて、ステップＳ５５０で目標濃度に対応する帯電バイアスを求め（ステップＳ５１０）、これを最適帯電バイアスとしてＲＡＭ１２７に記憶する（ステップＳ５１１）。ここで、測定結果（画像濃度）が目標濃度と一致している場合には、その画像濃度に対応する帯電バイアスを最適帯電バイアスとすればよく、また一致しない場合には、図１３（ｂ）に示すように、目標濃度を挟むデータＤ（Ｖａ05），Ｄ（Ｖａ06）に基づく直線補間などによって最適帯電バイアスを求めることができる。

【００５１】こうして最適帯電バイアスが求まると、既に現像バイアスとして最適現像バイアスを設定したのに加えて、上記のようにして算出された最適帯電バイアスをＲＡＭ１２７から読み出し、これを帯電バイアスとして設定する。そして、これらの設定の下で画像形成を行うと、目標濃度で画像を形成することができ、画像濃度の安定化を図ることができる。

【００５２】以上のように、この実施形態によれば、最適帯電バイアスおよび最適現像バイアスを求めて画像濃度を目標濃度に調整して画像濃度を安定化させることができる。特に、この実施形態では、各パッチ画像ＰＩ２を、互いに離隔配置された複数本の１ドットラインで構成しており、各パッチ画像ＰＩ２の画像濃度を検出し、その検出結果に基づきトナー像の画像濃度を目標濃度に調整しているため、Ｐ（Ｐ≧２）ドットラインからなる線画像がもとより、１ドットラインからなる線画像についても、画像濃度の安定化を図ることができ、精密な画像も適切な画像濃度で安定して形成することができる。

【００５３】また、最適帯電バイアスについては、その算出処理の直前に行われた処理によって求められた最適現像バイアスを現像バイアスとして設定した上で実行されるため、最適帯電バイアスを高精度に求めることができる。

【００５４】また、２回目以降の現像バイアス算出処理および帯電バイアス算出処理においては、直前の画像濃度測定結果（最適帯電バイアスおよび最適現像バイアス）に基づきバイアス算出を行っているため、短時間で、しかも精度良く最新の最適帯電バイアスおよび最適現像バイアスを求めることができる。

【００５５】Ｃ．パッチ画像について

ところで、上記実施形態では、現像バイアス算出処理ではベタ画像を第１パッチ画像として用いるとともに、帯電バイアス算出処理では複数本の１ドットラインを相互にｎライン間隔だけ離隔しながら、平行配置してなるハーフトーン画像を第２パッチ画像として用いているが、その理由は以下のとおりである。

【００５６】表面電位Ｖ０で均一に帯電された感光体２１の表面に、ベタ画像（第１パッチ画像）ＰＩ１（図７）に相当する静電潜像ＬＩ１を形成すると、図１５に示すように、その静電潜像ＬＩ１に相当する表面電位が電位（潜像低部電位）ＶＯＮまで大きく下げられて井戸型ポテンシャルが形成される。ここで、仮に帯電バイアスを増大させて感光体２１の表面電位を電位Ｖ０から電位Ｖ０′に高めたとしても、潜像低部電位は電位ＶＯＮから大きく変化しない。したがって、帯電バイアスが多少変動したとしても、現像バイアスＶｈに応じてトナー濃度が一義的に決定される。

【００５７】これに対し、表面電位Ｖ０で均一に帯電された感光体２１の表面に所定間隔ごとに１ドットラインＤＬを有するハーフトーン画像（第２パッチ画像）ＰＩ２（図１４）に相当する静電潜像ＬＩ２を形成すると、図１６に示すように、ライン位置に相当する表面電位が電位（潜像低部電位）ＶＯＮまで大きく下げられて、くし状の井戸型ポテンシャルが形成される。ここで、上記と同様に帯電バイアスを増大させて感光体２１の表面電位を電位Ｖ０から電位Ｖ０′に高めると、各ラインに対応する潜像低部電位は電位ＶＯＮから電位ＶＯＮ′に大きく変化する。したがって、帯電バイアスが変動すると、それに連動して現像バイアスＶｂに対応するトナー濃度の変動してしまう。

【００５８】このことから、ベタ画像を形成した場合、帯電バイアスがトナー濃度に及ぼす影響は少なく、現像バイアスを調整することでベタ画像の画像濃度を調整することができることがわかる。つまり、本実施形態の如くベタ画像を第１パッチ画像として用いた現像バイアス算出処理を実行する場合には、帯電バイアスの値にかかわらず最適現像バイアスを正確に求めることができる。

【００５９】また、画像を安定して形成するためには、最高階調（最高濃度）での調整を行っただけでは十分とはいえず、線画像の濃度調整をも行う必要がある。ただし、線画像のハーフトーン画像を用いた場合には、図１６に示すように、現像バイアスおよび帯電バイアスの設定値によって影響を受ける。そこで、この実施形態では、先に最適現像バイアスを算出しておき、現像バイアスを最適現像バイアスに設定した状態で帯電バイアスを変化させながら、ハーフトーン画像からなる第２パッチ画像を形成して目標濃度の画像濃度を得るために必要な最適帯電バイアスを算出している。

【００６０】さらに、線画像（第２パッチ画像ＰＩ２）を、複数本の１ドットラインを相互にｎライン間隔だけ離隔しながら、平行配置してなるハーフトーン画像で構成した理由は以下の通りである。すなわち、１ドットラインの画像濃度を調整するためには、第２パッチ画像ＰＩ２を単一の１ドットラインで構成し、これをパッチセンサＰＳで検出することも考えられるが、１ドットラインの画像濃度は極めて低くパッチセンサＰＳによる画像濃度の検出が困難である。そこで、本発明では、複数本

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の１ドットラインによりパッチ画像を構成することで、かかる問題を解消している。

【００６１】ここで、パッチ画像を複数本の１ドットラインで構成する場合、１ドットラインをどのように配置するのかが問題となってくる。というのも、露光ユニット３から感光体２１に向けて照射されるレーザ光Ｌは例えば図１７に示すようなガウス型の光強度分布を有しており、通常光強度の最大値に対して約５０％レベルでのスポット径が設計解像度に対応するように設計スポット径を調整することが多いが、この場合、露光パワーとして有効な$1/e^2$に対応する有効露光スポット径は設計スポット径よりも大きくなることから、隣接する１ドットラインＤＬ同士のライン間隔が狭い場合には、ライン間にトナーが付着してしまうからである。すなわち、隣接する１ドットラインＤＬ（図１６（ａ））のライン間隔ｎを１ラインとすれば、隣接する有効露光スポット同士が部分的に重なり合い、その重なり合った領域の表面電位を変化させてしまい、トナーが付着してしまう。したがって、隣接する１ドットラインＤＬのライン間隔については、最低でも２ライン以上の間隔を空ける必要がある。

【００６２】逆に、ライン間隔を広げすぎると、次のような問題が生じることがある。すなわち、パッチセンサＰＳによる画像濃度の検出感度はそのセンサＰＳの検出領域に入る１ドットラインＤＬの本数と密接に関係し、各１ドットラインＤＬの濃度変化をＸとし、検出領域に入ってくるライン数をｍとすれば、パッチセンサＰＳによって検出される画像濃度の変化量Δは、

$\Delta = m \cdot X$

となり、検出領域に含まれるライン数の増大にしたがって検出感度は高くなる。例えば、図１８（ａ）に示すように、ライン間隔ｎ1においてパッチセンサＰＳの検出領域ＩＲに入るライン数が５本の場合には、変化量Δａは、

$\Delta a = 5 \cdot X$

であるのに対し、同図（ｂ）に示すように、より広いライン間隔ｎ2（＞ｎ1）では、パッチセンサＰＳの検出領域ＩＲに入るライン数は４本に減少し、変化量Δｂは、

$\Delta b = 4 \cdot X$

となって、検出感度が低下する。

【００６３】種々の実験の結果、十分な濃度調整を行うためにはパッチセンサＰＳの検出感度を一桁程度向上させる必要があることがわかったが、そのためには検出領域ＩＲに入るライン数を１０本以上に設定する必要がある。ここで、検出領域ＩＲの大きさをϕ（ｍｍ）とし、装置の設計解像度、つまり単位長さ（１ｍｍ）に含まれるドット数をＲとすれば、ライン間隔をｎに設定した場合、検出領域ＩＲに入る１ドットラインの本数ｍは、

$m = \phi \cdot R / (1+n)$

となり、このｍが１０以上であるためには、

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$\phi \cdot R / (1+n) \geq 10$

を満足する必要がある。そして、この不等式を変形すると、

$n \leq (\phi \cdot R - 10) / 10 \quad \cdots \quad (1)$

となる。したがって、上記不等式（１）を満足するようにライン間隔ｎを設定することによって優れた検出感度でパッチ画像ＰＩ2の画像濃度を検出することができる。

【００６４】また、画像濃度をパッチセンサＰＳで読み取る場合、読み取り位置を変えながら読み取り動作を繰り返すことで検出精度の向上を図るが、１ドットラインが所定のライン間隔で平行配置されているパッチ画像を検出対象とする場合、パッチセンサＰＳの検出領域とパッチ画像との相対的な位置の相違によって、検出領域に含まれる１ドットラインの本数が最大で１本分異なる。パッチセンサＰＳの検出領域ＩＲとパッチ画像ＰＩ2との相対的な位置が、例えば図１９（ａ）に示すような場合には、検出領域ＩＲに入ってくる１ドットラインＤＬのライン数は５本であるのに対し、同図（ｂ）に示すような場合には、当該ライン数は６本となってしまう。このため、同一のパッチ画像ＰＩ2を読み取ったとしても、検出される画像濃度はずれてしまい、その検出ずれは

検出ずれ（％）＝（１／ｍ）×１００

ただし、ｍは検出領域ＩＲに含まれるライン数、となり、検出領域ＩＲに含まれる本数ｍが多くなるにしたがって、検出ずれが小さくなり、測定精度を向上させることができる。

【００６５】ここで、高精度の濃度制御を行うためには、この検出ずれを５％以内に抑える必要があり、ライン数ｍを２０本以上となるように設定するのが望ましい。つまり、次の不等式

$\phi \cdot R / (1+n) \geq 20$

を満足する必要がある。そして、この不等式を変形すると、

$n \leq (\phi \cdot R - 20) / 20 \quad \cdots \quad (2)$

となる。したがって、上記不等式(2)を満足するようにライン間隔ｎを設定することによって検出ずれを抑制し、さらに優れた検出精度でパッチ画像ＰＩ2の画像濃度を検出することができる。

【００６６】なお、本発明は上記した実施形態に限定されるものではなく、その趣旨を逸脱しない限りにおいて上述したもの以外に種々の変更を行うことが可能である。例えば、帯電手段として帯電ローラ２２を用いているが、帯電ブラシを用いてもよい。また、このように帯電ローラや帯電ブラシなどの導電体を感光体表面に接触させて帯電させる接触帯電の代わりに、非接触帯電手段によって感光体２１を帯電させる画像形成装置に対しても、本発明を適用することができる。

【００６７】また、上記実施形態では、パッチ画像ＰＩ

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2を複数本の１ドットラインＤＬを所定のライン間隔ｎで、しかも相互に平行となるように配置してなる画像としているが、例えば図２０に示すように、複数本の１ドットラインＤＬを格子状に配置してなる直交格子画像ＰＩ2′としてもよい。この場合、１ドットラインを平行配置したパッチ画像ＰＩ2（図１４）に比べてパッチセンサＰＳの検出領域ＩＲに入るライン数が増えてより検出感度が増大し、精度向上に対してより効果的である。また、ライン数が増えた分、ライン間隔ｎを広げることも可能となる。特に、副走査方向のライン間隔を広げることによって駆動方向の濃度ムラの影響を受けにくくなり、より安定した画像を検出して制御することができる。もちろん、パッチ画像の格子構造については、直交格子に限定されるものではなく、種々の格子を用いても同様の効果が得られる。

【００６８】また、上記実施形態では、４色のトナーを用いたカラー画像を形成することができる画像形成装置であったが、本発明の適用対象はこれに限定されるものではなく、モノクロ画像のみを形成する画像形成装置にも当然に適用することができる。また、上記実施形態にかかる画像形成装置は、ホストコンピュータなどの外部装置よりインターフェース１１２を介して与えられた画像を複写紙、転写紙、用紙およびＯＨＰ用透明シートなどのシートに形成するプリンタであるが、本発明は複写機やファクシミリ装置などの電子写真方式の画像形成装置全般に適用することができる。

【００６９】また、上記実施形態では、感光体２１上のトナー像を中間転写ベルト４１に転写し、このトナー像をパッチ画像として、その画像濃度を検出するとともに、その検出結果に基づき最適現像バイアスおよび最適帯電バイアスを算出しているが、中間転写ベルト以外の転写媒体（転写ドラム、転写ベルト、転写シート、中間転写ドラム、中間転写シート、反射型記録シートあるいは透過性記憶シートなど）にトナー像を転写してパッチ画像を形成する画像形成装置にも本発明を適用することができる。また、転写媒体にパッチ画像を形成する代わりに、感光体上のパッチ画像の濃度を検出するパッチセンサを設け、このパッチセンサによって感光体上の各パッチ画像の画像濃度を検出し、その検出結果に基づき最適現像バイアスおよび最適帯電バイアスを算出するようにしてもよい。

【００７０】また、上記実施形態では、最適現像バイアスおよび最適帯電バイアスはエンジンコントローラ１２のＲＡＭ１２７に記憶され、画像形成装置本体のメイン電源が落とされると、その記憶内容が揮発してしまい、再度メイン電源が投入されると、現像バイアス算出処理および帯電バイアス算出処理においては、「初回」と判断され、それに応じた処理が実行されるように構成されているが、順次求められる最適現像バイアスおよび最適帯電バイアスをＥＥＰＲＯＭなどの不揮発性メモリに記

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憶し、メイン電源の再投入時にも現像バイアス算出処理および帯電バイアス算出処理において「２回目以降」に対応する処理を実行するように構成してもよい。

【００７１】また、上記実施形態では、濃度制御因子として帯電ローラ２２に与える帯電バイアスを変化させながら、パッチ画像ＰＩ2，ＰＩ2′を順次形成しているが、その他の濃度制御因子、例えば現像バイアスや露光量などを変化させながら、複数本の１ドットラインからなるパッチ画像を作成してもよく、この場合も、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適値を決定することで、最適画像の画像濃度を安定化させることができる。

【００７２】さらに、上記実施形態では、広レンジおよび狭レンジにおいて４種類のバイアス値を設定しているが、レンジ内でのバイアス設定数（パッチ画像数）はこれに限定されるものではなく、複数種類であれば任意である。また、広レンジと狭レンジとでバイアス設定数を相違させてパッチ画像数を相違させてもよい。

【００７３】

【実施例】次に本発明の実施例を示すが、本発明はもとより下記実施例によって制限を受けるものではなく、前後記の趣旨に適合し得る範囲で適当に変更を加えて実施することも勿論可能であり、それらはいずれも本発明の技術的範囲に含まれる。

【００７４】この実施例では、次の条件：

設計解像度Ｒ：２３．６本／ｍｍ（６００ＤＰＩ）；

パッチセンサＰＳの検出領域ＩＲの大きさϕ：８ｍｍ；

でライン間隔ｎを変えながらパッチ画像を作成し、パッチセンサＰＳの検出電圧を測定したところ、図２１に示すグラフが得られた。このグラフに示された結果は、上記の「実施の形態の説明」の項で説明したライン間隔条件とよく一致している。

【００７５】すなわち、隣接する１ドットライン同士の影響を避けるためにはライン間隔ｎを２以上に設定する必要があるが、図２１から明らかなように、ライン間隔ｎを１に設定すると、ベタ画像と区別することができなくなっている。

【００７６】一方、十分な検出感度を得るためには、上記不等式(1)を満足するようにライン間隔ｎを設定するのが望ましく、この実施例では、

$n \leq (8 \times 23.6 - 10) / 10 = 17.88$（本）

を満足する、つまりライン間隔ｎを１７以下に設定するのが望ましい。この点、図２１から明らかなように、ライン間隔ｎが１８以上では、白紙画像と区別がつかなくなり、正確な画像濃度の検出が困難となっている。

【００７７】また、検出ずれを抑えて高精度な検出を行うためには、上記不等式(2)を満足するのが望ましく、この実施例では、

$n \leq (8 \times 23.6 - 20) / 20 = 8.44$（本）

を満足する、つまりライン間隔ｎを８以下に設定するの

が望ましく、この実施例では、ライン間隔ｎを５に設定するのが最も望ましい。

【００７８】

【発明の効果】以上のように、この発明によれば、互いに離隔配置された複数本の１ドットラインで構成されるトナー像をパッチ画像として形成し、このパッチ画像の画像濃度を検出するとともに、その検出結果に基づきトナー像の画像濃度を目標濃度に調整しているので、Ｐ（Ｐ≧２）ドットラインからなる線画像がもとより、１ドットラインからなる線画像についても、画像濃度を安定化させることができる。

【図面の簡単な説明】

【図１】この発明にかかる画像形成装置の一の実施形態を示す図である。

【図２】図１の画像形成装置の電気的構成を示すブロック図である。

【図３】図１の画像形成装置における濃度調整動作を示すフローチャートである。

【図４】図３の現像バイアス算出処理の内容を示すフローチャートである。

【図５】図４の広レンジでのバイアス算出処理の内容を示すフローチャートである。

【図６】図５の処理内容、および後で説明する狭レンジでのバイアス算出処理の内容を示す模式図である。

【図７】第１パッチ画像を示す図である。

【図８】パッチ画像の形成順序を示す図である。

【図９】図４の狭レンジでのバイアス算出処理（１）の内容を示すフローチャートである。

【図１０】図４の狭レンジでのバイアス算出処理（２）の内容を示すフローチャートである。

【図１１】図１０の処理内容を示す模式図である。

【図１２】図３の帯電バイアス算出処理の内容を示すフローチャートである。

【図１３】図１０の処理内容を示す模式図である。

【図１４】第２パッチ画像を示す図である。

【図１５】第１パッチ画像と、表面電位および現像バイアス電位との関係を示す図である。

【図１６】第２パッチ画像と、表面電位および現像バイアス電位との関係を示す図である。

【図１７】感光体表面に照射されるレーザ光の光強度分布を示すグラフである。

【図１８】ライン間隔の変化に伴うパッチセンサの検出領域と１ドットラインとの相対関係を示す模式図である。

【図１９】パッチセンサの検出領域と１ドットラインとの相対的な位置の変化に伴う検出ずれを説明するための図である。

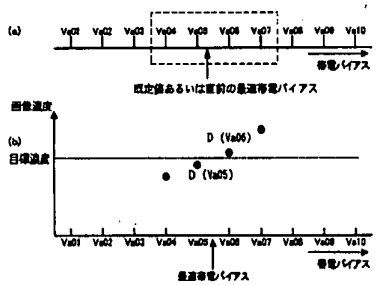
【図２０】パッチ画像の他の実施形態を示す模式図である。

【図２１】ライン間隔の変化に対するパッチセンサの出力変化の様子を示すグラフである。

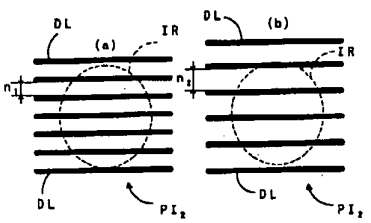
【符号の説明】

１…制御ユニット（制御手段）
２…像担持体ユニット
３…露光ユニット
１１…メインコントローラ（制御手段）
１２…エンジンコントローラ（制御手段）
２１…感光体
２２…帯電ローラ（帯電手段）
２３…現像部
２３Ｙ，２３Ｃ，２３Ｍ，２３Ｋ…現像器
４１…中間転写ベルト（転写媒体）
１２１…帯電バイアス発生部
１２３…ＣＰＵ（制御部）
１２５…現像バイアス発生部
１２７…ＲＡＭ（記憶手段）
ＩＲ…（パッチセンサの）検出領域
Ｌ…レーザ光
ＰＩ２…パッチ画像
ＰＩ２′…直交格子画像（パッチ画像）
ＰＳ…パッチセンサ（濃度検出手段）

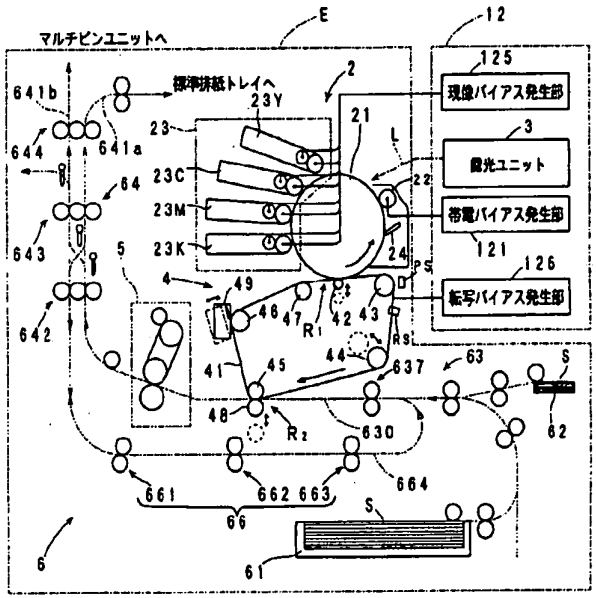
【図１３】



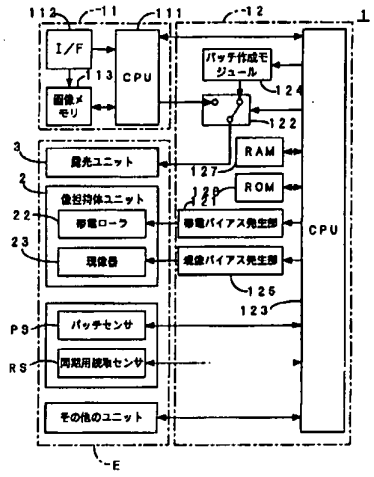
【図１８】



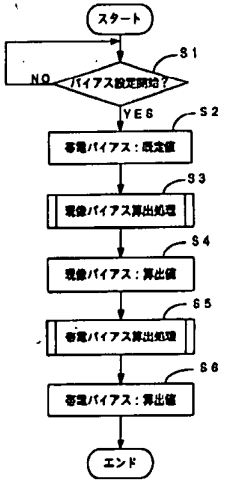
【図１】



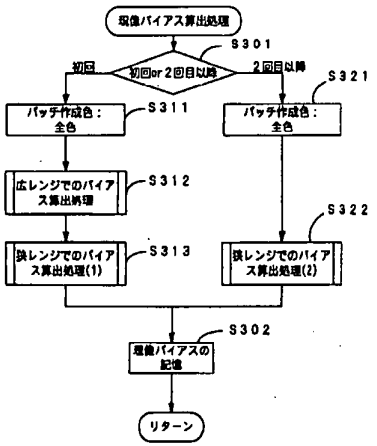
【図２】



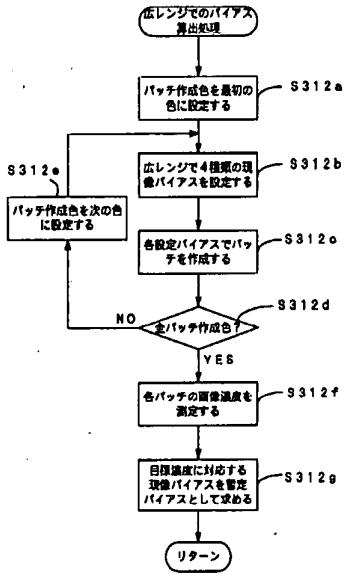
【図３】



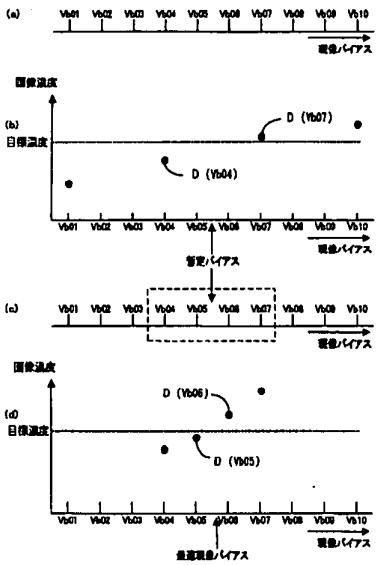
【図４】



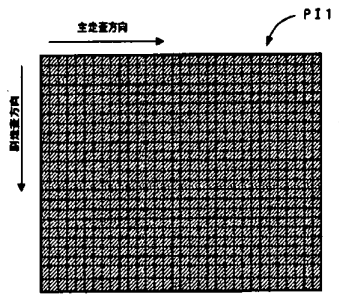
【図５】



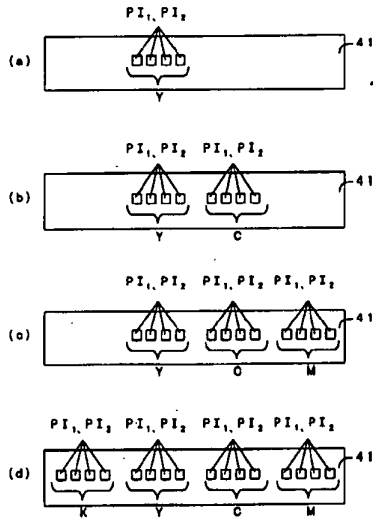
【図６】



【図７】



【図８】



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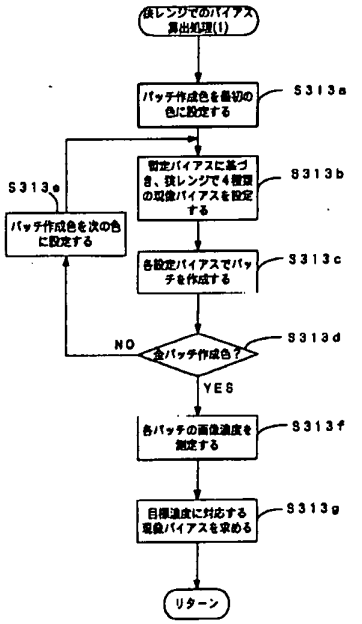
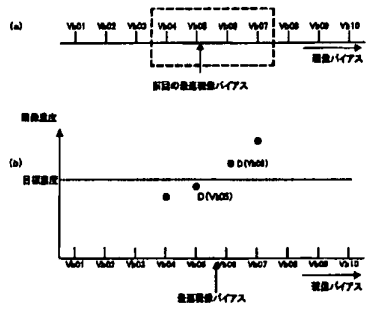
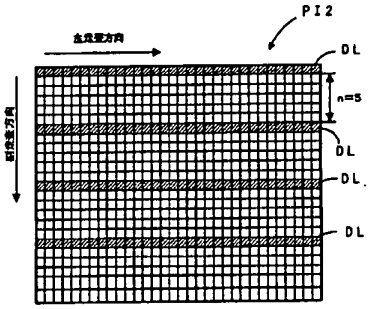


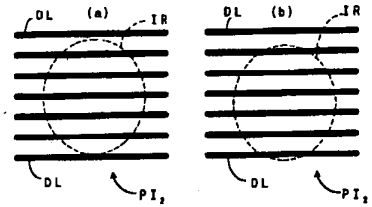
【図１１】



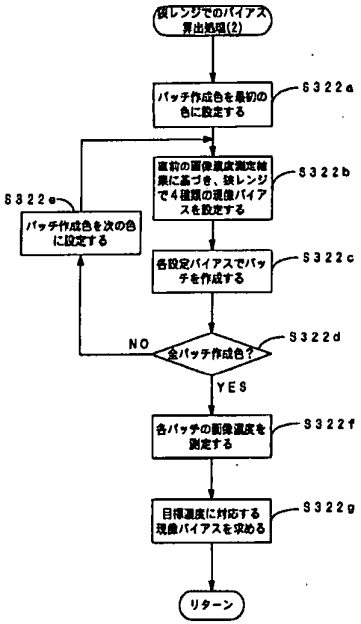
【図１４】



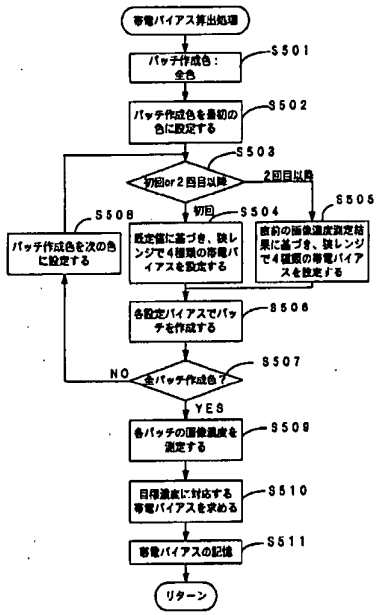
【図１９】



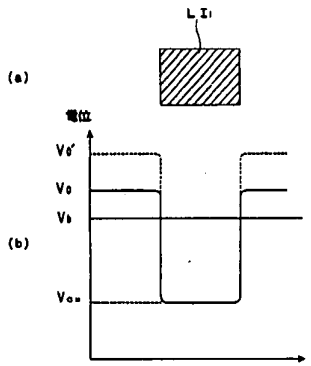
【図１０】



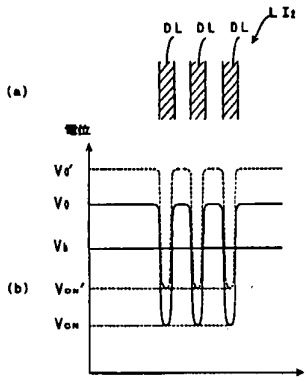
【図１２】



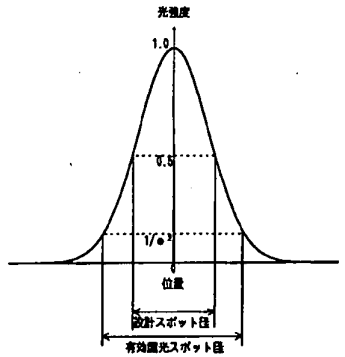
【図１５】



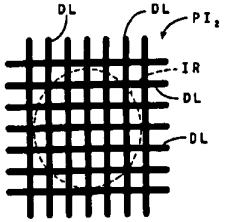
【図１６】



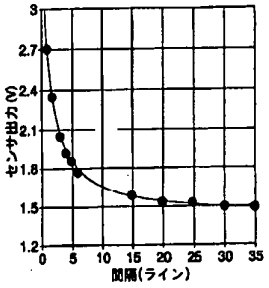
【図１７】



【図２０】



【図２１】



【手続補正書】

【提出日】平成１２年８月１０日（２０００．８．１０）

【手続補正１】

【補正対象書類名】明細書

【補正対象項目名】特許請求の範囲

【補正方法】変更

【補正内容】

【特許請求の範囲】

【請求項１】　帯電手段によって感光体の表面を帯電させた後、この感光体の表面に露光手段により静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成装置において、

前記感光体上で互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像をトナーにより顕在化することで得られるパッチ画像、あるいは当該パッチ画像を転写媒体に転写することで得られるパッチ画像の画像濃度を検出する濃度検出手段と、

トナー像の画像濃度に影響を与える濃度制御因子を変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位を変化させながら複数のパッチ画像を形成するとともに、前記濃度検出手段によって検出された各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備え、

前記濃度検出手段は、複数本の１ドットラインが入る検出領域を有していることを特徴とする画像形成装置。

【請求項２】　前記制御手段は、前記濃度制御因子として前記帯電手段に与える帯電バイアスを段階的に変化させることによって、前記感光体の表面電位のうち１ドットラインの表面電位と、前記現像手段に与えられる現像

バイアスとの相対関係を変化させて、互いに濃度が異なる複数のパッチ画像を形成する請求項１記載の画像形成装置。

【請求項３】　前記制御手段は、帯電バイアスを段階的に増大させながら、前記複数のパッチ画像を形成する請求項２記載の画像形成装置。

【請求項４】　前記帯電手段は、帯電バイアスが与えられた導電体を前記感光体の表面と接触させて当該表面を接触帯電させる請求項２または３記載の画像形成装置。

【請求項５】　前記制御手段は、前記濃度制御因子として前記露光手段から前記感光体に与えられる露光量を段階的に変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位と、前記現像手段に与えられる現像バイアスとの相対関係を変化させて、互いに濃度が異なる複数のパッチ画像を形成する請求項１記載の画像形成装置。

【請求項６】　帯電手段によって感光体の表面を帯電させた後、この感光体の表面に露光手段により静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成装置において、

前記感光体上で互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像をトナーにより顕在化することで得られるパッチ画像、あるいは当該パッチ画像を転写媒体に転写することで得られるパッチ画像の画像濃度を検出する濃度検出手段と、

トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら複数のパッチ画像を形成するとともに、前記濃度検出手段によって検出された各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備え、

前記濃度検出手段は、複数本の１ドットラインが入る検出領域を有していることを特徴とする画像形成装置。

【請求項７】　前記複数本の１ドットラインは、相互にほぼ平行であり、しかも、隣接する１ドットライン同士はｎライン間隔（ｎ≧２の整数）だけ離隔している請求項１ないし６のいずれかに記載の画像形成装置。

【請求項８】　前記濃度検出手段は大きさφの検出領域を有し、また前記画像形成装置は解像度Ｒを有するとき、隣接する１ドットライン同士のライン間隔ｎは、

ｎ≦（φ・Ｒ－１０）／１０

をさらに満足する整数である請求項７記載の画像形成装置。

【請求項９】　前記濃度検出手段は大きさφの検出領域を有し、また前記画像形成装置は解像度Ｒを有するとき、隣接する１ドットライン同士のライン間隔ｎは、

ｎ≦（φ・Ｒ－２０）／２０

をさらに満足する整数である請求項７記載の画像形成装置。

【請求項１０】　前記パッチ画像は、前記複数本の１ドットラインを格子状に配置してなる格子画像である請求項１ないし４のいずれかに記載の画像形成装置。

【請求項１１】　前記パッチ画像は、前記複数本の１ドットラインを相互に直交配置してなる直交格子画像である請求項１０記載の画像形成装置。

【請求項１２】　帯電手段によって感光体の表面を帯電させた後、この感光体の表面に露光手段により静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成方法において、

互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子を変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位を変化させながら、前記感光体上に形成する工程と、

各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、

複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、

各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えたことを特徴とする画像形成方法。

【請求項１３】　前記濃度制御因子として、前記帯電手段に与える帯電バイアスを段階的に変化させることによって、前記感光体の表面電位のうち１ドットラインの表面電位と、前記現像手段に与えられる現像バイアスとの相対関係を変化させて、互いに濃度が異なる複数のパッチ画像を形成する１２記載の画像形成方法。

【請求項１４】　帯電バイアスを段階的に増大させながら、前記複数のパッチ画像を形成する請求項１３記載の画像形成方法。

【請求項１５】　前記濃度制御因子として前記露光手段から前記感光体に与えられる露光量を段階的に変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位と、前記現像手段に与えられる現像バイアスとの相対関係を変化させて、互いに濃度が異なる複数のパッチ画像を形成する請求項１２記載の画像形成方法。

【請求項１６】　帯電手段によって感光体の表面を帯電させた後、この感光体の表面に露光手段により静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成方法において、

互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら、前記感光体上に形成する工程と、

各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、

複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、

各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えたことを特徴とする画像形成方法。

【請求項１７】　前記複数本の１ドットラインは、相互にほぼ平行であり、しかも、隣接する１ドットライン同士はｎライン間隔（ｎ≧２の整数）だけ離隔している請求項１２ないし１６のいずれかに記載の画像形成方法。

【請求項１８】　パッチ画像の検出領域の大きさをφとし、解像度をＲとしたとき、隣接する１ドットライン同士のライン間隔ｎが、

ｎ≦（φ・Ｒ－１０）／１０

をさらに満足する整数となるように、前記パッチ画像を形成する請求項１７記載の画像形成方法。

【請求項１９】　パッチ画像の検出領域の大きさをφとし、解像度をＲとしたとき、隣接する１ドットライン同士のライン間隔ｎが、

ｎ≦（φ・Ｒ－２０）／２０

をさらに満足する整数となるように、前記パッチ画像を形成する請求項１７記載の画像形成方法。

【請求項２０】　前記パッチ画像を、前記複数本の１ドットラインを格子状に配置してなる格子画像としている請求項１３ないし１６のいずれかに記載の画像形成方法。

【請求項２１】　前記パッチ画像を、前記複数本の１ドットラインを相互に直交配置してなる直交格子画像としている請求項２０記載の画像形成方法。

【手続補正２】

【補正対象書類名】明細書

【補正対象項目名】０００５

【補正方法】変更

【補正内容】

【０００５】この発明は、帯電手段によって感光体の表面を帯電させた後、この感光体の表面に露光手段により静電潜像を形成し、さらに現像手段によって前記静電潜像をトナーにより顕在化してトナー像を形成する画像形成装置および画像形成方法に関するものであり、上記目的を達成するため、以下のように構成している。この発明にかかる画像形成装置の一態様は、前記感光体上で互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像をトナーにより顕在化することで得られるパッチ画像、あるいは当該パッチ画像を転写媒体に転写することで得られるパッチ画像の画像濃度を検出する濃度検出手段と、トナー像の画像濃度に影響を与える濃度制御因子を変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位を変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えている。また、この発明にかかる画像形成方法の一態様は、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えている。

【手続補正３】

【補正対象書類名】明細書

【補正対象項目名】０００６

【補正方法】変更

【補正内容】

【０００６】この発明にかかる画像形成方法の一態様は、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子を変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位を変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えている。また、この発明にかかる画像形成方法の一態様は、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有するように構成している。また、この発明にかかる画像形成装置の別の態様は、前記感光体上で互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像をトナーにより顕在化することで得られるパッチ画像、あるいは当該パッチ画像を転写媒体に転写することで得られるパッチ画像の画像濃度を検出する濃度検出手段と、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら複数のパッチ画像を形成するとともに、前記濃度検出手段によって検出された各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備えている。そして、前記濃度検出手段が複数本の１ドットラインが入る検出領域を有するように構成している。

【手続補正３】

【補正対象書類名】明細書

【補正対象項目名】０００６

【補正方法】変更

【補正内容】

【０００６】この発明にかかる画像形成方法の一態様は、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子を変化させることによって前記感光体の表面電位のうち１ドットラインの表面電位を変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって前記複数のパッチ画像の画像濃度をそれぞれ検出する工程と、各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する工程とを備えている。また、この発明にかかる画像形成方法の一態様は、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像を複数個、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら、前記感光体上に形成する工程と、各パッチ画像用静電潜像をトナーにより顕在化して複数のパッチ画像を形成する工程と、複数本の１ドットラインが入る検出領域を有するように構成している。また、この発明にかかる画像形成装置の別の態様は、前記感光体上で互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像用静電潜像をトナーにより顕在化することで得られるパッチ画像、あるいは当該パッチ画像を転写媒体に転写することで得られるパッチ画像の画像濃度を検出する濃度検出手段と、トナー像の画像濃度に影響を与える濃度制御因子として前記現像手段に与える現像バイアスを変化させながら複数のパッチ画像を形成するとともに、前記濃度検出手段によって検出された各パッチ画像の画像濃度に基づきトナー像の画像濃度を目標濃度に調整する制御手段とを備えている。そして、前記濃度検出手段が複数本の１ドットラインが入る検出領域を有するように構成している。

【手続補正４】

【補正対象書類名】明細書

【補正対象項目名】０００７

【補正方法】変更

【補正内容】
【０００７】これらの発明では、互いに離隔配置された複数本の１ドットラインで構成されるパッチ画像が、トナー像の画像濃度に影響を与える濃度制御因子を変化させながら、複数個形成される。そして、各パッチ画像の画像濃度が、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって、検出される。この後、これらの画像濃度に基づきトナー像の画像濃度が目標濃度に調整されて１ドットラインからなる線画像の画像濃度の安定化が図られる。
【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】０００８
【補正方法】変更
【補正内容】
【０００８】なお、画像濃度の調整については、例えば次のように行ってもよい。すなわち、トナー像の画像濃度に影響を与える濃度制御因子として帯電手段に与える帯電バイアスを変化させながら、複数のトナー像をパッチ画像として順次形成した後、各パッチ画像の濃度を検出し、それらの画像濃度に基づいて目標濃度を得るために必要な最適帯電バイアスを決定すればよい。
【手続補正６】
【補正対象書類名】明細書
【補正対象項目名】００４５
【補正方法】変更
【補正内容】
【００４５】Ｂ－２．最適帯電バイアス算出処理
図１２は、図３の帯電バイアス算出処理の内容を示すフローチャートである。また、図１３は、図１０の処理内容を示す模式図である。この帯電バイアス算出処理（ステップＳ５）では、すべての色（この実施形態では、イエロー（Ｙ）、シアン（Ｃ）、マゼンタ（Ｍ）、ブラック（Ｋ）の４色）についてパッチ画像を形成する旨の設定を行った（ステップＳ５０１）後、ステップＳ５０２に進んで第２パッチ画像を作成する色を最初の色、例えばイエローに設定する。
【手続補正７】
【補正対象書類名】明細書
【補正対象項目名】００５７
【補正方法】変更
【補正内容】
【００５７】これに対し、表面電位Ｖ０で均一に帯電された感光体２１の表面に所定間隔ごとに１ドットラインＤＬを有するハーフトーン画像（第２パッチ画像）ＰＩ２（図１４）に相当する静電潜像ＬＩ２を形成すると、図１６に示すように、ライン位置に相当する表面電位が電位（潜像低部電位）ＶＯＮまで大きく下げられて、くし状の井戸型ポテンシャルが形成される。ここで、上記と同様に帯電バイアスを増大させて感光体２１の表面電位を電位Ｖ０から電位Ｖ０′に高めると、各ラインに対応する潜像低部電位は電位ＶＯＮから電位ＶＯＮ′に大きく変化する。したがって、帯電バイアスが変動すると、それに連動して現像バイアスＶｂに対応するトナー濃度も変動してしまう。
【手続補正８】
【補正対象書類名】明細書
【補正対象項目名】００７４
【補正方法】変更
【補正内容】
【００７４】この実施例では、次の条件：
設計解像度Ｒ：２３．６本／ｍｍ（６００ＤＰＩ）；
パッチセンサＰＳの検出領域ＩＲの大きさφ：８ｍｍ；
でライン間隔ｎを変えながらパッチ画像を作成し、パッチセンサＰＳの検出電圧を測定したところ、図２１に示すグラフが得られた。このグラフに示された結果は、上記の「発明の実施の形態」の項で説明したライン間隔条件とよく一致している。
【手続補正９】
【補正対象書類名】明細書
【補正対象項目名】００７８
【補正方法】変更
【補正内容】
【００７８】
【発明の効果】以上のように、この発明によれば、トナー像の画像濃度に影響を与える濃度制御因子を変化させながら、互いに離隔配置された複数本の１ドットラインで構成されるトナー像をパッチ画像として複数個形成し、このパッチ画像の画像濃度を、複数本の１ドットラインが入る検出領域を有する濃度検出手段によって検出するとともに、その検出結果に基づきトナー像の画像濃度を目標濃度に調整しているので、Ｐ（Ｐ≧２）ドットラインからなる線画像はもとより、１ドットラインからなる線画像についても、画像濃度を安定化させることができる。